DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

MARCH, 1942

Railroads are almost as important to a nation at war as industries engaged in producing fighting equipment and other supplies for the armies and navies. It is vital that the wartime products be conveyed with dispatch to required points and that troops be transferred quickly between military bases. April MACHINERY, which will be a Railroad Production Number, will outline the manufacturing methods employed by leading builders of locomotives, railway cars, and allied equipment; and maintenance operations performed in the shops of several outstanding railroad systems. The articles will indicate the magnitude of the job being accomplished by the use of machine tools and other metal-working equipment in keeping railroad rolling stock in running order.

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Number 7

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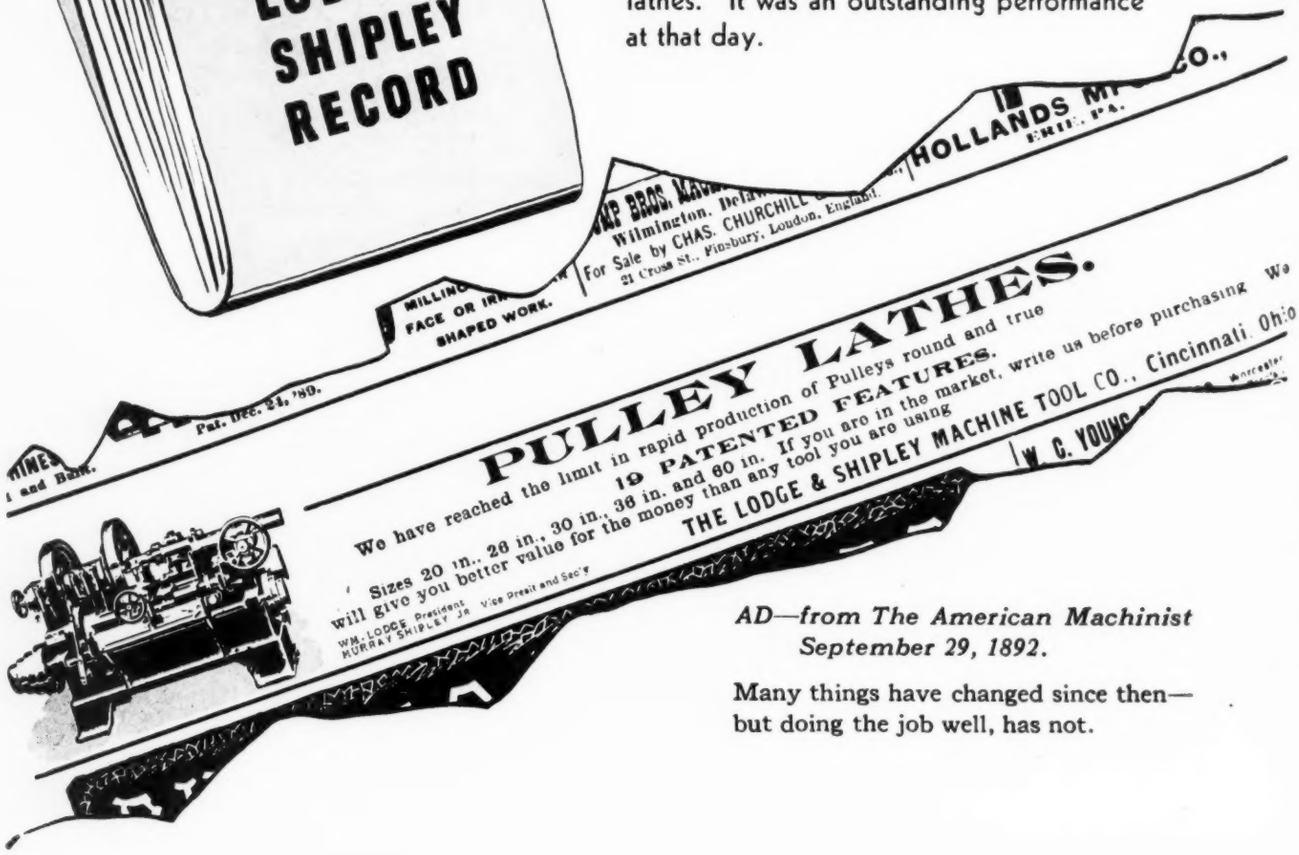
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MACHINERY

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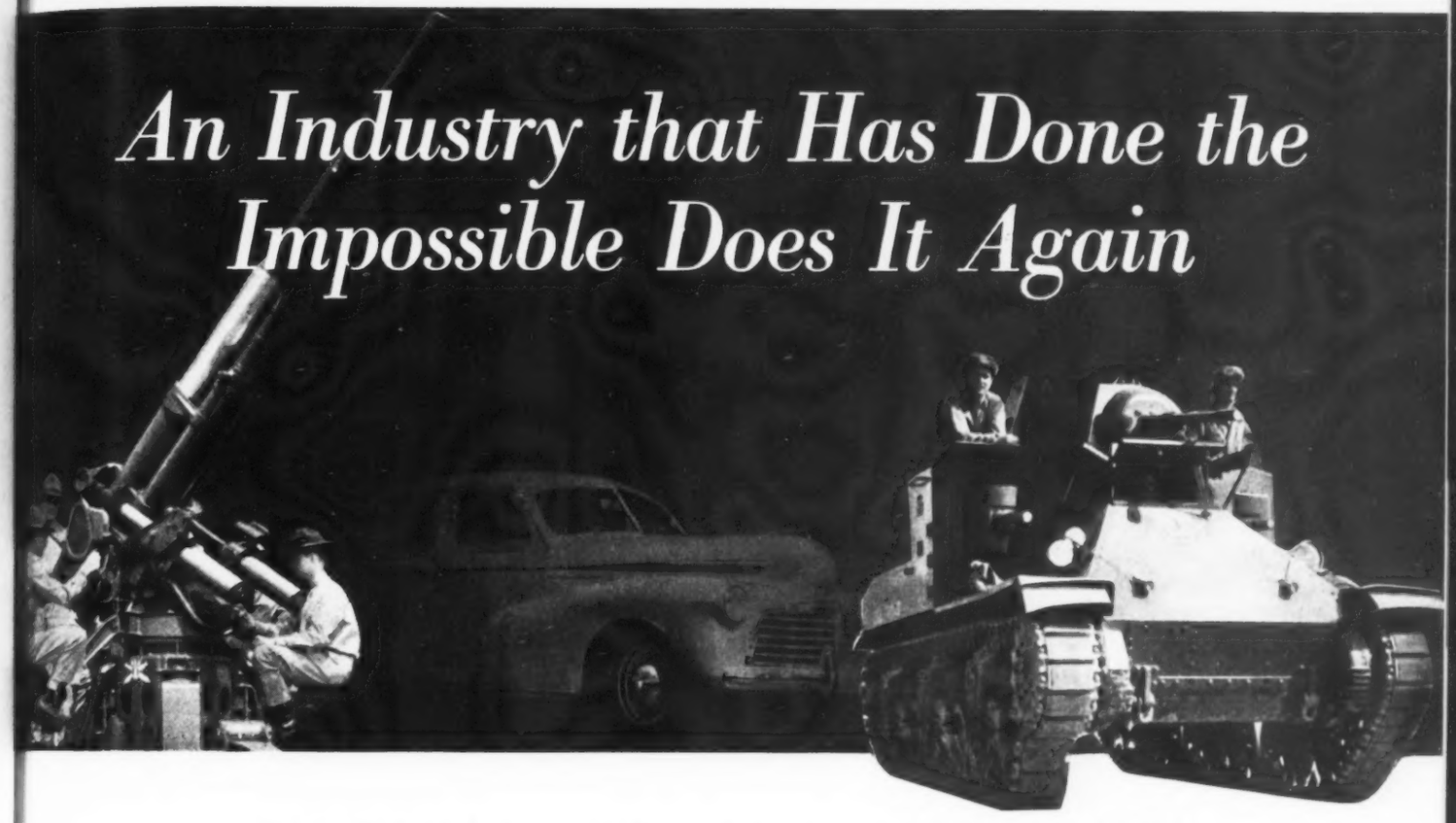
An Industry that Has Done the Impossible Does It Again



Facts Relating to Part Played by the Automotive Industry in Producing War Equipment, as Recorded in Interviews with Chief Executives of America's Leading Automobile Companies

AT this time, when there has been so much published on the relation of the automotive industry to war material production, it is to the point to quote a statement made a few years ago before the American Society of Mechanical Engineers by the late C. F. Hirshfeld, chief of research of the Detroit Edison Co., and one of the keenest minds in the engineering field. Said Mr. Hirshfeld: "My observation is that the automotive industry has been, and still is, guided by men of tremendous courage, with perseverance verging toward obstinacy. The phrase 'It cannot be done' is replaced by the much more fruitful one 'It must be done.'"

The secret of the success of the automotive industry could not have been stated more tersely. This industry has on many occasions in the past done the "impossible." Both from the engineering and production points of view, it has achieved successes that even the boldest minds in the industry would not have deemed possible a few years previously. Now that this industry has been given the opportunity to use its keen business judgment and trained engineering minds in the solution of the problem of producing war equipment, it is safe to predict that it will achieve outstanding results equal to those that it has accomplished in peaceful production.

In order to place on record what the automotive industry has done in the present crisis, and to give the facts in the words of the men most thoroughly conversant with the problems met and the work done by this industry, the Editor of MACHINERY has interviewed the executive heads of General Motors, Chrysler, Ford Motor, Hudson, and Studebaker.

These interviews show how the automotive industry has met the present emergency and how it has responded to the needs of the Nation, not only by doing what it has been asked to do, but frequently by taking the initiative and asking for contracts to manufacture war material even before the Government was in a position to place these contracts.

An Interview with Charles E. Wilson President, General Motors Corporation

Question: When did General Motors first engage in defense production work?

Mr. Wilson: In June, 1940, when this emergency was first recognized as being a serious one for the United States, and Congress made the first appropriation for defense of approximately seven billion dollars, General Motors had already completed the development of four- and six-wheel drive Army trucks, as well as Allison aviation engines and Diesel engines for submarines and other Navy equipment. Furthermore, the corporation had already negotiated a pilot order for 500 machine guns, and was prepared to expand production on these items rapidly.

At that time, all the executives of General Motors were called upon by the management to cooperate with the Government in planning for the production of defense material, to give engineering cooperation, and to prepare for the production of defense items for which we could obtain orders and for which we could get equipment for production.

We also planned to spread the load geographically and to seek defense work for each of our plants, or for at least one plant in each of the cities in which we have factories. This objective has been largely accomplished, and as early as last fall we had about 500 defense contracts for material produced in 60 different plants and in 35 different cities. Some of the corporation's facilities, of course, are only partly usable for the production of war materials, but these facilities will be converted for this use as rapidly as possible.

It must be understood that the production of war material is a big business which must be organized for quantity production and manufactured by methods such as are used in making typical American products, like electrical machinery, railroad equipment, farm implements, tractors, refrigerators, washing machines, calculating machines, radios, and last but not least, automobiles.

To get this job done promptly and efficiently, it must be handled by executives, engineers, and mechanics who are experienced in the planning, purchasing, material control, and production of this type of product. To train a completely new organization to handle a big defense job would require too much time and would result in greatly added costs, in addition to the delay. This is why existing organizations can handle the task before us so much better than any organization built "from the ground up."

It is almost impossible to collect quickly from various sources a large group of men who will work efficiently and intelligently together and be willing to subordinate their own individual ambitions and ideas for the common good of the enterprise. This, of course, is one of our big national problems in Washington today, and I am very sympathetic with it.

Consequently, the least dislocation of employment and general disorganization of industry will take place if the defense business is allotted to organizations in proportion to their capacity and ability to produce similar products, taking into consideration the number of employes available in these organizations.

Obviously, we in General Motors are anxious to keep our organization of 300,000 men and women employed and to engage in war production to the fullest extent possible. The cessation of the passenger car business has made it necessary to lay off or transfer to other work at least 100,000 of our people. These people, and a great many more, will be gradually reabsorbed in the war production work. By the end of the year, employment should be equal to the highest peak reached in 1941, and this peak may eventually be exceeded.

Question: What war equipment has General Motors so far contracted to supply?

Mr. Wilson: Actually, the contracts now on hand call for the manufacture of hundreds of different items. Broadly classified, however, General Motors is manufacturing aircraft equipment; tanks, including power units; guns, gun mounts and controls, machine guns and rifles; marine Diesel engines; shells, shot, cartridge cases and fuses; trucks; and electrical equipment.

Question: What is the General Motors capacity for war material production?

Mr. Wilson: At the beginning of the year, General Motors produced war material at the rate of $700,000,000 a year. By next fall, we expect this production rate to be increased to $2,000,000,000 annually. Some time next year, on the basis of present orders, we should reach an annual rate of production of $3,700,000,000. We expect that we will handle about 10 per cent of the country's total war production.

It may be of interest to mention what these figures mean in terms of actual fighting equipment. It looks to me as if General Motors will be building one-third of all the machine guns;

one-half of the Army trucks; no battleships, to be sure, but half of the Navy's Diesel engines; 30 per cent of the aviation engines; one-fifth of the tanks; and substantial quantities of anti-aircraft and anti-tank guns.

Question: Has the General Motors Corporation so far been able to meet the requirements of the Government?

Mr. Wilson: I believe I can answer this question with a definite "yes" without inviting any serious contradictions. On January 1, this year, the General Motors Corporation had delivered war materials to a value of over $400,000,000. In some cases, it has been possible to complete installation of the necessary special facilities ahead of schedule. Unusual production adjustments have, in some cases, permitted rapid acceleration of deliveries. Conspicuous in this category is the naval gun-housing production, for which the Fisher Body plant, engaged in this work, received the Navy "E" award for excellence. In the case also of shells, machine guns, and Diesel engines for naval use, the volume of deliveries is well ahead of the original schedules.

In the earlier stages of the Defense Program, deliveries of Allison aircraft engines did not meet the original contract schedules. By October 1, last year, they had, however, reached 91 per cent of the schedules projected for that time, and by the end of the year the production equalled the full scheduled rate. Furthermore, the shortages that occurred during the initial stages of the program are now being overcome. At first, the Allison production was handicapped by the rapid and repeated expansion of facilities and—to some degree—by the necessity of making changes to adapt the engine to alterations in plane design; but the Air Corps is now getting its Allisons—getting them in the quantities asked; getting them by the time specified.

Furthermore, from hundreds of sub-contractors come parts and sub-assemblies; and what is the greatest satisfaction of all, from our test cells come Allison engines far superior to the original pattern—engines delivering 235 more horsepower each than was initially specified, achieved without change in engine size and with reduced weight per horsepower. In this one of our greatest tasks today, therefore, our first mission is completed. Production is on schedule; in fact, it looks as if we were going to be able to produce more than the plant was originally laid out for, and we expect to run that plant at capacity production until the war is over. Already thousands of Allison engines are giving a fine account of themselves throughout the world.

On anti-aircraft guns, we are about six months ahead of what we promised to do.

CHARLES E. WILSON

Question: What are some of the other important projects in which the General Motors Corporation is engaged?

Mr. Wilson: One of the largest projects of General Motors is the production of Pratt & Whitney aircraft engines, which are being built by Buick and Chevrolet. Buick-built aviation engines are rolling from the assembly lines in increasing quantities. The Buick Division has brought to completion one of the largest defense plant projects in the National War Production Program.

Besides the rapid adaptation of two large automobile factories to aircraft engine production, the project included the construction and equipment of an entirely new plant for the final assembly and testing of engines. This plant was completed considerably ahead of schedule as a result of day and night building operations. Production of aircraft engines was started within eight months from the moment that ground was broken for the new plant. So vast was this undertaking that as many as 1800 construction workers were on the job daily.

Including the two Buick automobile plants that are producing aircraft engine parts and sub-assemblies, the entire plant lay-out is one of the most modern yet constructed for aircraft engine manufacture. It has been designed specifically for this kind of work, following automotive technique and production-line methods, with all the huge manufacturing departments under one roof.

Other General Motors war projects include facilities for the production of bomber parts and sub-assemblies by the Fisher Body Division, which is in production on a considerable number of items that comprise its part in the bomber program.

A more recent development is a project calling for the production by Cadillac and Fisher Body of light, medium, and heavy tanks, including, in some instances, the supplying of the power plants. It must be kept in mind that the preparation for such highly technical and entirely new production work normally requires a period approaching a year, even though there is no undue delay in the procurement of the machine tools and special facilities required, and that the point of maximum productivity cannot be reached the moment the plant goes into operation.

Question: You mentioned that by January 1, this year, the General Motors Corporation had delivered over $400,000,000 worth of war materials. At that time, what was the value of the orders still unfilled on the books of the corporation?

Mr. Wilson: On January 1, we had received a total of $1,620,000,000 worth of war material orders. Having delivered about 25 per cent of this volume, we had on that date about $1,210,000,000 worth of unfilled war orders. Between January 1 and 10, we received $769,330,000 worth of additional orders, and on January 10 we were negotiating for further orders amounting to $1,368,000,000. This makes a grand total of war orders to be filled of approximately $3,350,000,000. New contracts are constantly being negotiated and placed, so that this figure will be materially increased in the near future. In fact, it will be considerably larger by the time this interview is published.

Question: There has been a great deal said about the subject of "conversion," and it has been intimated that the automotive industry did not convert its plants to war work as quickly as might have been desirable. What comment would you make on that point?

Mr. Wilson: I am glad you mentioned the subject of conversion. I like to discuss that. Some people think that conversion is a new idea. As I recently said to another audience, it is nothing new to the automobile industry. The readers of MACHINERY well understand that. Every time we bring out a new model, we do a conversion job. We call it retooling and plant rearrangement. We have converted our plants every year.

Question: What methods do you consider most practical for the conversion of the present automotive plants to war work?

Mr. Wilson: Probably one of the most practical developments is the exchange of machines, tools, and manufacturing knowledge. There is no doubt but that the automobile manufacturers can accomplish their war production goals in the same way that this industry has, in the past, developed the automobile industry to the largest metal-manufacturing business in the world.

The task before the industry is tremendous, and the job can be accomplished only with imagination and a great deal of hard work. The problems cannot be solved simply by mysterious plans or catchwords, such as "pooling" and "sub-contracting." Of course, the industry will make use of all the advantages to be gained by pooling brains and swapping equipment, and will subcontract wherever it is practical and advantageous; but these items are only two details of a far more complicated problem. However, the industry has both the past experience and the resources to solve it.

Some people think that conversion is a new idea. It is nothing new to the automobile industry. Every time a new model is brought out, a conversion job is done. It is called retooling and plant rearrangement in the automotive industry. That industry has practically converted its plants every year. There is no doubt but that the automobile manufacturers can accomplish their war production goals by employing the same means that they have used in the past in developing the automobile industry to the largest metal-manufacturing business in the world.

In my opinion, the term "pooling" has been used pretty loosely. Those who have been asking for pooling have never clearly defined what they mean. As a practical matter, you can pool ideas and you can pool technical information; but when it comes to physical things, you either have to bring the work to the machine or the machine to the work.

Obviously, you cannot pool all the machines in a single location; but, in another sense, the automobile industry is already tied together in one great pool. For years we have made parts and materials for one another. Our engineers and research men have exchanged new ideas and technical developments through the Society of Automotive Engineers. Recently, we agreed to make tools for one another and to release machinery that we were not using for war work to any one who could use such machinery on their war contracts.

The automobile industry has always been a cooperative industry, and we have pooled those things that could be pooled.

Question: It has frequently been asked: What percentage of the automotive plants is it feasible to convert to war production? What is your opinion on that?

Mr. Wilson: I want to answer that question as I have once before. That question is like asking how much an animal weighs. It makes some difference whether it is an elephant or a mouse; and so with conversion. It all depends upon what we are asked to convert to. If General Motors were asked to start to build battleships or destroyers, we could not use any of our facilities. We could not convert anything. On the other hand, if it is a matter of making army trucks, as much as 95 to 97 per cent of our present machinery and facilities can be employed.

Question: It has been said that the automobile industry has been slow to use its own facilities for war production, and that it has insisted that the Government provide new facilities for this work?

Mr. Wilson: I am glad to have a chance to present the facts in this matter. General Motors has asked for new facilities only when they were absolutely necessary, either in the interest of efficient mass production or because we were being called upon to produce something that required entirely new methods and plants. I would like to quote some figures to substantiate this.

Up to November 30, 1941, the Government had given industry as a whole 20 cents worth of facilities for each dollar of war contracts. General Motors had received only 10 cents worth of new facilities for each dollar of its contracts. These figures indicate that General Motors has done twice as well as industry in general in the use of its existing facilities in the war effort.

Question: What do you consider is the biggest problem that the industry is facing in getting war material operations into full swing? Is it politics? Machinery or tools? Materials? Or indecision as to what is required?

Mr. Wilson: I would not say that any one of these factors in itself presents an insurmountable problem. The fact of the matter is that there is a much bigger job to be done than the public realizes. What the public is clamoring for now is to reap wheat immediately, although we did not sow wheat six or eight months ago.

The public does not realize that you cannot stop making automobile engines tonight and begin making aviation engines or tanks in the same plant tomorrow morning. I want emphatically to say that the difficulty is not with the automobile industry or any other industry. The trouble is that the American people did not realize early enough the seriousness of the situation. They were not willing or able to face the facts, and Pearl Harbor came as a surprise to them. Now they wonder why industry is not in full capacity war production.

As I have said before, I do not really understand what this row over conversion is all about. I will say this: No change is required in the way the automobile companies do business, in order to get the maximum effort on this war job. The different companies, even though they have been competitors, have done business with each other for years—since the beginning of the industry. I, myself, have sold materials to Ford and Chrysler—two competitors—as well as to our own divisions.

Many people ask "What percentage of the automotive plants is it feasible to convert to war production?" That depends upon what the industry is asked to convert to. If an automobile plant were asked to build battleships or destroyers, it could not use any of its facilities. On the other hand, if it is a matter of making army trucks, the industry can use probably from 95 to 97 per cent of the present machinery and facilities. The word "conversion," like the word "pooling," has been loosely used by people who are not thoroughly informed.

We have made it clear that if we have machinery in any of our plants that we cannot use for this war effort, we will list it, and anybody that can use it on defense work can have it. Likewise, if we have any raw materials on hand that we do not need, due to this sudden change in the production plans of the industry, we will make it available to anybody who can use it. I believe that other industries are willing to do the same thing, and I cannot see that there is anything further required in the way of joint management, pooling, or new laws, or changing the rights of ownership under which we have done business as a democratic nation.

This conversion problem comes back to the question: What are you retooling for? For example, for certain trucks, engines are used that are somewhat larger than the Chevrolet standard engines. The conversion of the tools for that job, since the truck engine is a valve-in-head engine, very similar to that of the Chevrolet, is a relatively simple job.

But if you tried to make aviation engines with the equipment available for Chevrolet engines, you would find that there was a relatively small amount of the equipment that could be used. This is a point which, of course, the general public cannot understand; and only men with long experience in doing the same kind of work,

like our automobile production engineers, can do this work efficiently. It can be done only by hard work—not by talk and plans.

Question: What about sub-contracting? Could the industry accomplish more by more sub-contracting?

Mr. Wilson: That is another subject I like to talk about. Sub-contracting is nothing but buying parts from other people. In the automobile industry, particularly, all the companies, including General Motors, have bought parts from other shops regularly. It has been a recognized part of our business. At one stage in the automobile industry, in fact, some companies did practically nothing but assembling of cars.

It used to be a sort of joke around the industry that if you just called the parts and accessories suppliers together, they could design you a car in thirty days and make the parts for you; and all you needed to do was to get a building and put the parts together. To this industry, there is nothing new about sub-contracting. We are perfectly conversant with that part of the business—we are doing, and will do, all that can be done along that line.

We feel that we should take the more difficult things and the bigger units—things that the smaller companies cannot do. Then, where we have capacity that is idle, we will also make the smaller items. This matter of idle capacity is a point worth mentioning. The kind of equipment of which we and other automobile manufacturers have a surplus is the same kind of equipment of which nearly everybody else has a surplus. Generally speaking, it is machinery for making smaller parts of which there is a surplus, whereas there is a scarcity of the heavy type of machinery required for tanks and of some of the equipment for airplane engines.

Question: Someone recently said that if the automotive industry had not produced so many cars last year, it could have been making more guns, tanks, or planes. What are the facts in that case?

Mr. Wilson: The industry could not have produced more guns, tanks, or planes without more contracts for guns, tanks, and planes. The industry went ahead as fast as the Army and Navy placed orders, and the Army and Navy went ahead just as fast as Congress appropriated money. General Motors constantly tried to get new orders for war materials, constantly sought more defense business. The Army and Navy frequently discussed future business with us—so that we might be ready to produce—even before the money was available. General Motors offered to build tanks more than a year ago, but the money appropriated for tanks was all allocated and our services were not needed then.

You must remember that until Pearl Harbor, nobody thought much about the possibility that we might have to fight somewhere with tanks. Until Pearl Harbor, we were building for defense, not for war. If we had gotten more defense orders, we would have been able to handle them, in spite of the fact that we were turning out cars for civilian purposes, because even in 1941, our plants had not reached capacity. General Motors made a substantial expansion of its facilities in 1937. Those facilities have never been utilized to full capacity. We still had surplus facilities in 1941. We did not even build as many passenger cars as we could have, and we didn't get as many defense orders as we could have filled.

Question: It has been said that the car production last year consumed a great deal of valuable materials that could have been used for war material production. What are the facts?

Mr. Wilson: The principal material used in making automobiles is steel. There is not yet any shortage of steel as a metal. The shortage has been for certain types of steel, such as armor plate and steel made into certain shapes. The sheet steel that goes into cars cannot be used for making planes, tanks, guns, or battleships. The proof of this is the fact that the automobile industry had no priority rating for any material in its passenger car production, so that any material used was of a character that was not required for war production.

As a matter of fact, I think that the building of automobiles last year was a good thing for the country. At the time, it was a question of either building cars or shutting down and discharging hundreds of thousands of workers. Furthermore, I am convinced that the country will need all the transportation that the cars built in 1941 can provide before the war is over.

Question: What has been the effect of the cessation of passenger car manufacture on employment?

Mr. Wilson: Obviously, the effect has been a serious one. In order to provide the greatest possible opportunity for employment adjustments, the defense authorities wisely applied a curtailment program on a progressive scale. Still these successive reductions have released employes at a faster rate than they could be immediately absorbed by the defense work now assigned to General Motors.

As additional defense work is assigned to General Motors, defense jobs will increase accordingly, although the extent and dates of such increases depend not only on when new contracts are received, but on the nature of the material ordered and the length of time required for securing tools and equipment. However, it is expected that ultimately an all-time peak employment will be reached by General Motors, as its war production gets into full swing.

An Interview with K. T. Keller
President, Chrysler Corporation

Question: When did the Chrysler Corporation first become active in defense work?

Mr. Keller: In March, 1940, the directors of Chrysler Corporation decided to take on any defense work that the company could do creditably. Within ninety days we undertook our first large and complicated defense contract—the building of 28-ton medium tanks. In the interim we took on educational contracts for such items as 3-inch shells and cartridge cases, in addition to manufacturing a large volume of specially designed Dodge army trucks. Early in 1941 we took volume orders for anti-aircraft guns, bomber fuselages, and a wide variety of other war items. Later in the year we took on volume contracts for ammunition, airplane engines, tank engines, and a new line of military vehicles.

Question: Approximately what is the dollar value of the Government contracts for war equipment that have been placed with Chrysler Corporation?

Mr. Keller: Any quotation of a dollar figure would probably be out of date very soon after it was made. I would rather say that when the corporation is in full production on the contracts that it already has, it will be turning out finished goods at a dollar volume rate three times as large as during average normal domestic production, or about twice as large as during peak domestic business.

Question: Has Chrysler Corporation production to date met the Government requirements?

Mr. Keller: This question, I think, can best be answered by saying that the production of tanks in the Chrysler Tank Arsenal last year was double what anyone hoped it would be, and is now being tripled. We are looking forward to turning out 28-ton tanks at the rate of a train load a day. Also, our gun production has been multiplied by five, and we are turning out specially designed vehicles for the Army of many different sorts in very large volume. There is also a wide variety of other equipment that we are producing or getting ready to produce. Of course, the most spectacular war work that the corporation has undertaken is the tank job, and when the present expansion program is completed, it will be even more spectacular.

Question: To what extent has it been possible to adapt present plant facilities to war production?

Mr. Keller: Recent surveys indicate that the corporation has approximately 15,000 machine

tools in its various plants. Of these, more than 11,000 are already on war work or have been designated for specific war jobs that we are to do. The few thousand that at the moment do not seem adaptable to war work will be listed with the Automobile Manufacturers Association Council for War Production, so that if other companies need them for special war work, they can be used. Many of these machines, however, are either of such a special-purpose nature that they cannot be adapted to other work or are of types of which there is a surplus.

Question: Is there anything that could be said on the score of the employment situation?

Mr. Keller: Chrysler Corporation normally employs from 70,000 to 75,000 workers. When we get into full production on the war work now on our books, we will probably need from 100,000 to 125,000.

Question: Is there any other phase of the automotive industry's activities in war work on which you would care to comment?

Mr. Keller: Yes, I would like to state that the Chrysler Corporation wants to do all it possibly can for the nation's war program. The work of getting this enormous program going at full speed is receiving our undivided attention.

An Interview with Charles E. Sorensen Vice-President, Ford Motor Co.

Question: When did the Ford Motor Co. first engage in defense work activities?

Mr. Sorensen: In October, 1940, the Government was proceeding on the theory that all the automobile factories could do to speed the production of planes was to make parts for the airplane manufacturers. Mr. Knudsen came here from Washington and asked us what we could do to help. We told him, and he was greatly pleased.

A month later, we saw him again. By that time he was of the opinion that we would be asked to enter upon a greatly enlarged program, and conveyed the information that the production of cars might be greatly cut in 1942.

In February, 1941, at the request of the Army, we were asked to look over a bomber to determine whether we could produce such planes in quantities. We said we could. The Army wanted such planes produced in a separate plant, and we designed one. Sixty days later, we were told that the planning was satisfactory and that we would unquestionably be called upon to do the job.

And then, without a dollar of Government money, without so much as a telegram telling us to go ahead, we made a start. We had our plans completed, and acres of ground cleared—all at the expense of the Ford company—before an order came through. It cost us millions of dollars to do the job we did in getting buildings ready and installing machinery for manufacturing Pratt & Whitney airplane motors; and instead of holding back and wasting time, as some seem to think that the automobile industry has done, we have advanced by months the day on which we shall be producing engines in great quantities. Looking at the whole picture of the war production effort, I think the automotive industry has done a great job.

The point I want to make is that we have been ahead of the Government's requests in every case. We have carried the ball as far as we dared without having actually received the orders, and the record shows it.

Question: Could the unemployment due to suddenly stopping the manufacture of automobiles have been avoided?

Mr. Sorensen: I think that it could have been —at least, to a very large extent. The Government rules, which have resulted in laying off thousands of workmen while the automobile plants are being transformed into arsenals, could, in my opinion, have been modified to avoid this lay-off. We, at Ford, do not think that this dislocation of labor was necessary. We laid out a plan, on which we agreed with the heads of labor, that would have made the transfer a painless one.

VICTORY

An Interview with A. E. Barit
President, Hudson Motor Car Co.

Question: When did Hudson first begin to work on defense equipment?

Mr. Barit: Hudson's first work on the Defense Program was begun in October and November, 1940.

Question: What general classes of equipment are now being made by the Hudson organization?

Mr. Barit: Hudson is the sole source of supply for certain parts used in aeronautical engines. These parts are now made by mass production methods. Parts for bomber planes are also being made. In a new U. S. Naval Ordnance plant, the Hudson organization is producing anti-aircraft guns and a wide variety of naval ordnance ranging from gun mounts to delicate fire control apparatus. This U. S. Naval Ordnance plant was designed as a permanent unit of the United States Armament Program.

Question: What is the dollar value of the Government contracts so far placed with Hudson?

Mr. Barit: On January 2, the Hudson organization was engaged in filling contracts totaling $120,000,000. Since that time, additional contracts have been placed with Hudson and others are now being negotiated. A considerable proportion of the materials made under these contracts have already been delivered to the United States Government.

Question: Has the Hudson Motor Car Co. built any additions to take care of war work production? Has any appreciable part of an existing plant been converted to doing Government work?

Mr. Barit: The new U. S. Naval Ordnance plant built by Hudson for the U. S. Navy within the past year is operated by Hudson for the Navy Department. The cost of this plant was

in excess of $20,000,000, and it is the largest ordnance plant in the area where it is located. The grounds cover 135 acres—approximately thirty-six city blocks. The plant comprises fourteen buildings having over 1,000,000 square feet of floor space. It will provide employment for many thousands of workers, the majority of whom are highly skilled machine tool operators and mechanics. Parts of the Hudson plants have been converted from automobile production to work on aircraft and airplane parts. Sections of the plant that have not yet been converted are being adapted to war work as rapidly as it is possible to do so.

VICTORY

An Interview with Paul G. Hoffman President, The Studebaker Corporation

Question: When did the Studebaker Corporation begin its defense work activities?

Mr. Hoffman: The Studebaker Corporation started on its Defense Program approximately a year ago. At that time, the corporation agreed to construct and operate for the Government three entirely new plants for the manufacture of aircraft engines under license from the Wright Aeronautical Corporation. The manufacture of Wright engines will represent the corporation's major contribution to the war effort. In addition, however, we have been producing for several months heavy-duty military trucks for the Army. We also expect before very long to have additional contracts for several items of war equipment. At this time, however, I am not in a position to mention these specific items.

Question: Approximately what is the dollar value of the Government contracts for war work that have been undertaken by the Studebaker Corporation? In a general way, are these contracts for materials for which an automotive organization and plant are adapted?

Mr. Hoffman: At the present time, we have Government contracts for aircraft engines and military trucks, and some other items amounting to a total value of over $300,000,000.

Question: What has been done in the way of conversion of present plant facilities to war work?

Mr. Hoffman: I don't see how I can answer that question, because the word "conversion" by itself is, to all intents, meaningless. I can, however, tell you what we are doing in an effort to make the fullest possible use of our passenger car manufacturing facilities in the production of war materials.

First, we are greatly expanding our military truck program, and in so doing will utilize some of the facilities released by the stoppage of passenger car production.

Second, we are currently negotiating with the Government for contracts for armament items, in the manufacture of which we believe we could make the greatest possible use of the remainder of those facilities.

I might add that, when we agreed to take on the production of aircraft engines, we studied the possibility of producing these engines in our then existing plants and with the machinery used in the manufacture of automobiles. We found, however, that passenger car manufacturing facilities are entirely unsuited for the production of aircraft engines.

Question: A great deal has been said about the Government and other organizations taking a more decided part in the management of the automotive industry to assist in accelerating war production. What comments would you make on those suggestions?

Mr. Hoffman: I feel that the automotive industry can accomplish what is required of it without regimentation. The formerly competing units of the industry will direct their competition against Hitler and cooperate fully with each other. The industry will pool its brains and will utilize its facilities just as fast as war contracts are placed.

There are those who suggest that if we are to accomplish this task, we must give up our freedom and submit to dictatorship. If I believed that to be true, I would offer no objection; but it so happens that this is a doctrine that I consider utterly false. I believe, with all my heart and soul, that free management and free labor, each doing its part of the job, in cooperation with each other and with the Government, can out-produce any nation in which labor is enslaved and management shackled. Instead of trying to get Hitler's results by imitating Hitler's methods, we must surpass his results by using the methods that made us the leading industrial nation in the past.

Developments in Load-Center Power Distribution

The basic principles of what is known as load-center power distribution for industrial plants were explained at a meeting arranged by the General Electric Co., January 23, in New York City. Briefly, this system permits the locating of sub-stations at the points throughout the plant where the power is chiefly utilized. This means that there are shorter secondaries; a saving of materials; reduced line losses; and improved voltage. Since the sub-stations are complete self-contained units, almost all of the installation and construction expense and time delay associated with the old type sub-station methods are eliminated. The presentation graphically illustrated these points, and models were used to further clarify the subject.

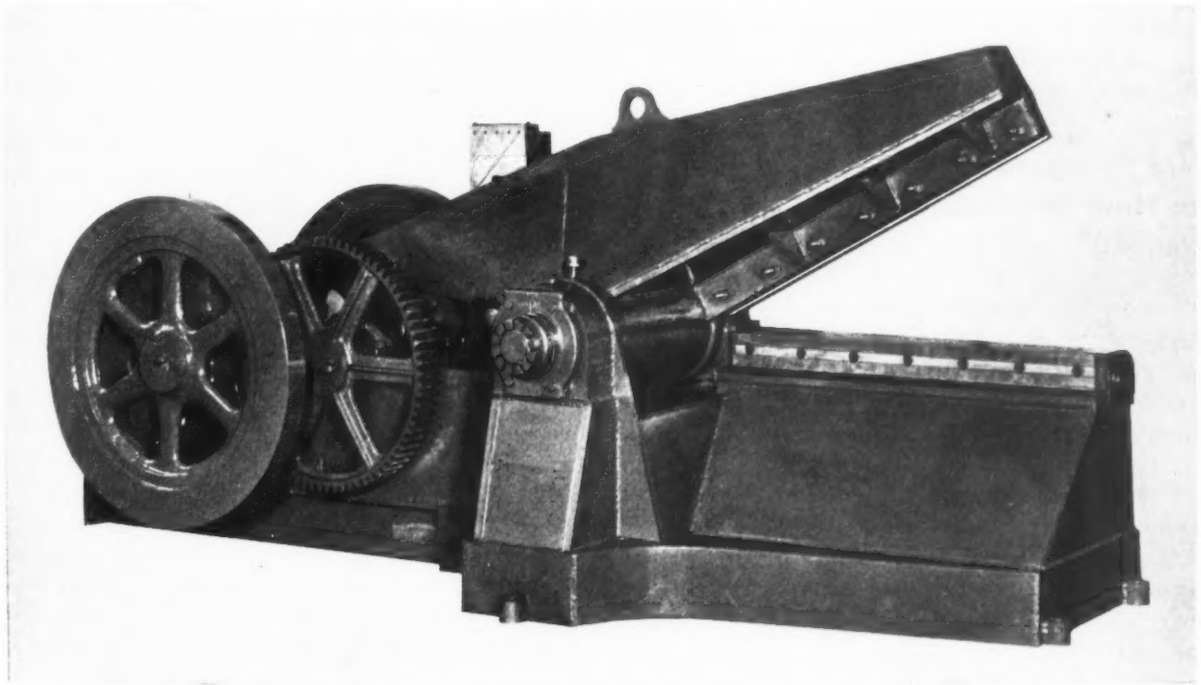
Load-center power distribution, as such, is not new, having been applied for years in the public utility field. However, the development of new equipment has now made it possible to extend its advantages to industrial plants and other buildings, where it offers many advantages. A new bulletin (GEA-3758) is available from the General Electric Co., Schenectady, N. Y., on the subject, listing the chief advantages of the load-center power distribution system, illustrating the available circuit arrangements, describing the necessary equipment for such a system, and depicting typical installations of load-center unit sub-stations.

Large Arc-Welded Shear Speeds up the Cutting of Scrap

The demand for scrap iron and steel has also created a demand for large shears capable of cutting up huge pieces of metal, such as automobile bodies, into sizes suitable for baling and shipment. The engineers of the Canton Foundry & Machine Co., Cleveland, Ohio, were faced with the problem of designing a shear with a 48-inch blade, of considerable strength—yet not too heavy and unwieldy. Arc-welded steel-plate construction was decided upon, the arc-welding being done with Lincoln equipment.

The entire shear, as shown in the accompanying illustration, weighs 12,000 pounds. If built in the conventional manner, it would have been far heavier. In addition to saving weight, the arc-welded construction was found to be less expensive, since it saved the making of elaborate patterns and castings.

This big shear cuts through automobile bodies, fenders, cowls, doors, oil-drums, stoves, and the like, at as many as thirty cuts per minute. The top blade of the shear is bolted to a heavy angle iron, which has been strengthened by arc-welding triangular steel sections to it. The angle, in turn, is arc-welded to a box-like strengthening member, fabricated by arc-welding together pieces of steel plate. The base of the machine, the bearing support, and other parts are all joined by welding. The result is a strong, relatively light shear, of pleasing appearance.



Huge Power Shear of Arc-welded Steel Construction, with a Blade 48 Inches Long. A Great Saving in Weight was Achieved by Welding. The Shear is Used for Cutting up Large Pieces of Scrap Metal, such as Automobile Bodies, Heavy Pipe, and Water-heater Boilers

EDITORIAL COMMENT

Special Threads Complicate Manufacturing Methods

The war equipment program is being slowed up by the frequent use of special threads on war equipment. One manufacturer of threading equipment states that the war orders have introduced hundreds of different kinds of chasers, for the manufacture of which special tooling equipment is needed. A great deal of work has been done to standardize screw threads with a view to providing threads that would fit practically every reasonable requirement. Why not use standard threads and standard diameters wherever possible?

War Emergency Leads to New Methods of Training

The present emergency has forced many important changes in industrial educational methods. New methods have been tried out and found successful. Intensive training courses have been adopted, both in shops and in trade schools. Vocational training schools, many of which have not been held in the highest esteem by industrialists in the past, have been forced to adopt effective teaching methods as a result of the emergency, and are giving good account of themselves in the preliminary training of defense workers. Some of the state trade schools that had previously established the highest reputation for effective work have achieved even more surprising results now. Many of these schools run three shifts, twenty-four hours a day.

The public schools are finding new ways for training their students to do useful work and to earn a living, rather than merely giving them a general academic education. High school courses designed to fit young men for work in industry rather than for college have been developed. Important industrial subjects are beginning to find their place in high school curricula.

As pointed out by Frank W. Curtis, president of the American Society of Tool Engineers, all of this has made necessary the selection of new types of instructors—men who have an industrial background, men who right now occupy important positions in industry. Their spare time is virtually drafted for educational purposes, in order that the needs of industry be fully appreciated in the school training. The war requirements have created an entirely new conception of industrial education.

Skilled Men Serve Their Country Well Right at Home

The patriotism of the American industrial worker has been amply demonstrated by the large number of men engaged in manufacturing pursuits who have left their work in the shops to enlist in the armed forces. This spirit is commendable. It shows that in the face of national emergency and danger, Americans can be depended upon to do their bit. The theories of the dictators of Europe and their satellites have been disproved. We are not a nation as soft as they believed. But the question arises: Does a man always serve his country to the best of his ability by being in the armed forces? Many of the men who have enlisted are highly skilled and are extremely difficult to replace. Their work in helping to speed up the production of armaments is as important as—if not more important than—their active military service. In some cases, the enlistment of such men has seriously hampered munitions production.

Right at the moment, what the United States needs most is not men in the armed forces, but men of skill and ability behind the lines, to provide the fighting equipment for the men in the Army and Navy. Such men are so urgently needed in the war industries that they should be asked not to leave the important work that they are doing.

The Government can help in this matter by advising recruiting officers to discourage men needed in war materials production from enlisting. The withdrawal of these men from industrial work is a serious matter at this time.

From Printing Presses to Gun Mounts

A Concern that Builds Printing Presses in Times of Peace has Turned to the Production of Naval Gun Mounts, as it Did in the First World War

By CHARLES O. HERB

DESTROYERS and light cruisers now being constructed for the United States Navy will be equipped with gun mounts built in a shop that ordinarily makes printing presses. This plant—that of the Goss Printing Press Co. —is engaged at present in building mounts for 5-inch anti-aircraft guns. However, the venture is not an entirely new one for the fifty-seven year old concern, as it also turned to gun mount production in the first World War.

In the present national emergency, this concern has already won the Navy "E" pennant for excellence in the production of naval ordnance. It has been manufacturing gun mounts for more than a year and completed its first contract several months ago. Important operations in this plant will be described in this article.

Approved for Publication by the Navy Department

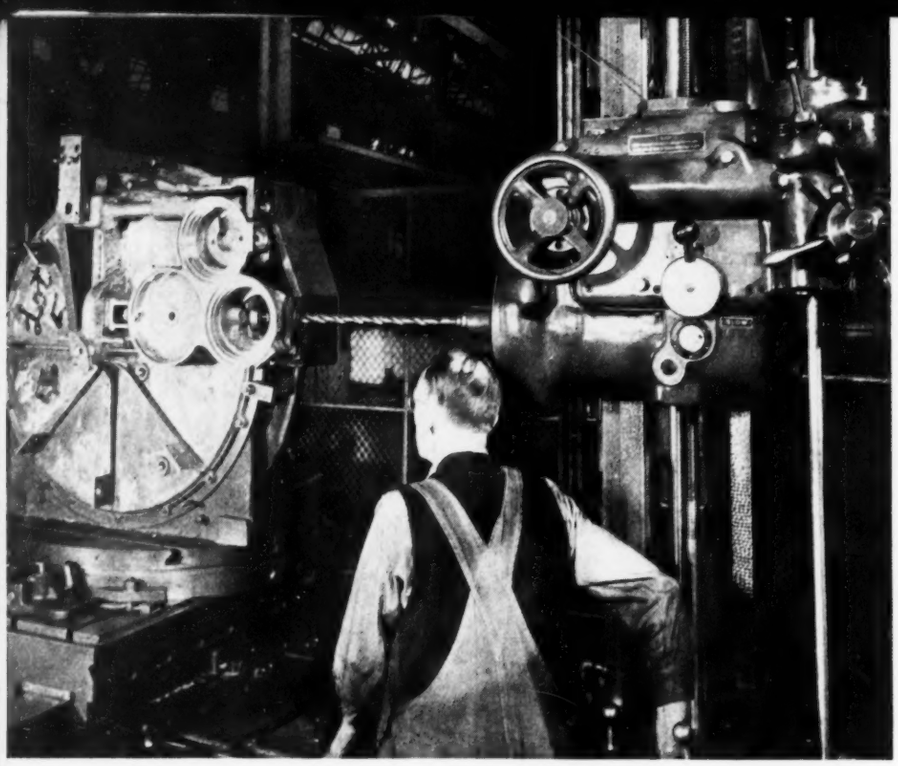


Fig. 1. One Hundred Different Operations are Performed on a Gunsight Casting to Close Tolerances on a Horizontal Boring Mill

Extreme degrees of accuracy must be attained in making many of the parts for the gun mounts. For example, in machining the indicator and dial housing for the gun sight, tolerances as close as plus or minus 0.0005 inch must be maintained on center-to-center distances and diameters. This casting is seen being machined on a Universal horizontal boring, drilling, and milling machine in Fig. 1. All together, more than one hundred different boring and facing operations are performed on the housing while it is set up on this machine. The boring mill is equipped with a circular table, so as to enable all sides of the work to be indexed toward the machine spindle.

At the time that the photograph was taken, the machine was engaged in drilling a hole about 3/4 inch in diameter to a depth of 30 inches. The drill is 18 inches long. When the hole was drilled to about that depth, an extension was mounted on the spindle sleeve of the machine to enable the drill to be fed to the total depth of 30 inches. It will be observed from the illustration that the drill is guided by two bushings on the jig.

Pads on four sides of an elevating bracket for the gun mounts are face-milled in the operation shown in Fig. 2, which is performed on a Sellers horizontal boring, drilling, and milling machine having a 5-inch spindle. This machine is equipped with a table 5 feet wide and about 10 1/2 feet long. Castings up to 6 feet high can be accommodated on the machine.

As the practice is to hold all dimensions as close as possible to scraping requirements in the particular operation shown, the surfaces are

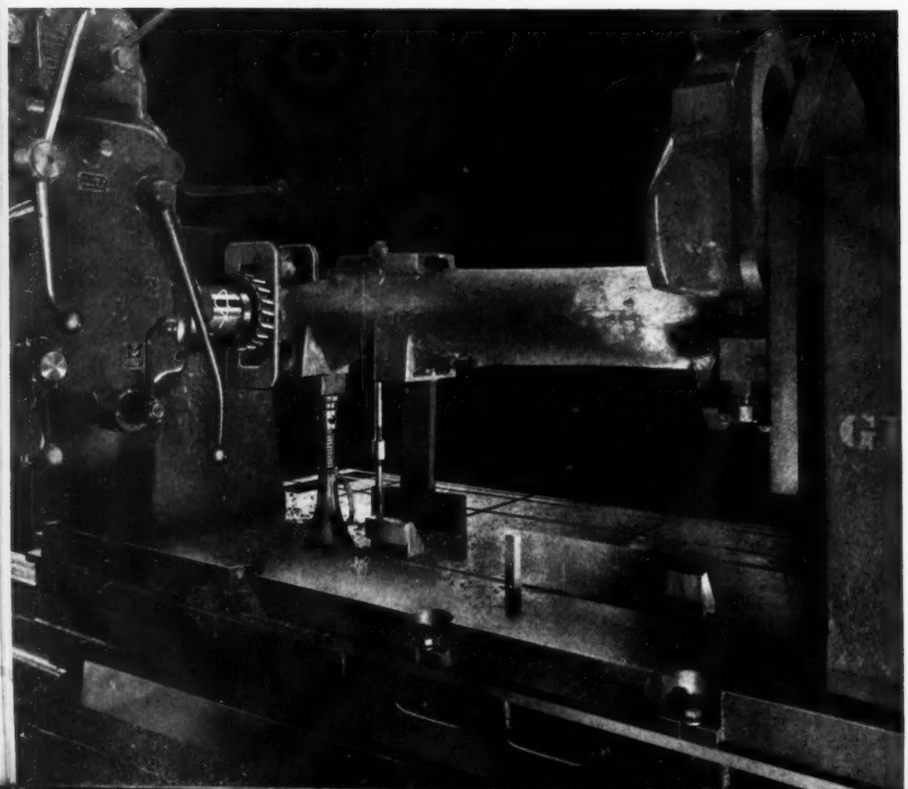


Fig. 2. Elevating Brackets for the Gun Mounts are Face-milled on Four Sides by Employing This Horizontal Boring Mill, which is Equipped with an Indexing Fixture

Fig. 3. Accurate Milling Operation being Performed on the Base Pads of a Gun Carriage by Employing a Planer Type Milling Machine

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milled to within plus or minus 0.001 to 0.0015 inch. From 0.003 to 0.004 inch of stock is allowed for removal by scraping. An O.K. inserted-blade milling cutter is seen on the machine spindle. The work fixture is of an indexing type, which permits the elevating bracket to be quickly turned over and locked in position for machining each of the four sides.

Permanently fastened to the fixture are hardened and ground blocks with vertical faces that coincide with the centers from which the work is supported. These blocks facilitate setting the cutters closely for milling the various pads to the required distances from the center of the work. The elevating bracket is bored before it comes to this operation and is seated at each end on plugs in the fixture.

A large Cincinnati planer type milling machine is used for many finishing operations on the larger parts of the gun mounts. Fig. 3 shows the machine being employed for milling four pads on the bottom of a gun-carriage casting. The pads had already been face-milled at the time that the photograph was taken, and the machine is seen engaged in milling one end of a pad. It is necessary to mill all around the edges of the pads, because their lengths are held within a close tolerance.

When this operation is completed, the gun carriage is set up in an upright position on the table of the machine, usually in a group consisting of several carriages, for face-milling the bosses on both sides of the arms. The gun carriages are cast from steel of high tensile strength. The machine is equipped with a table 24 feet long, and measures 96 inches between housings.

Fig. 4. Duplex Type of Cutter-head by Means of which Two Surfaces on the Inside of the Projectile-hoist Housing are Simultaneously Planed to the Required Radii

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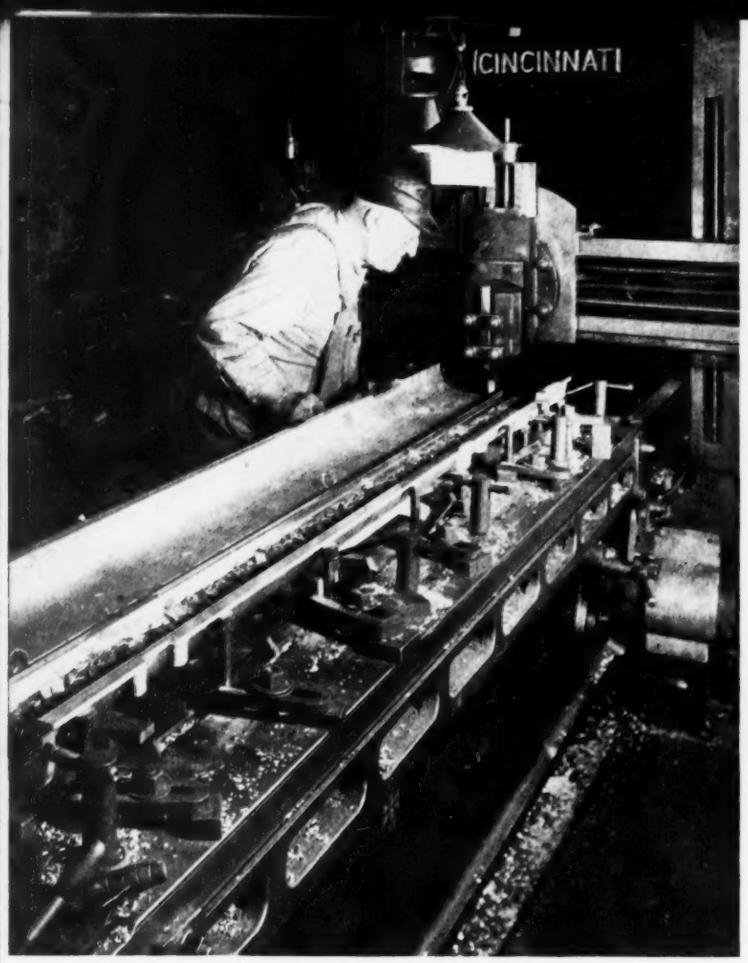
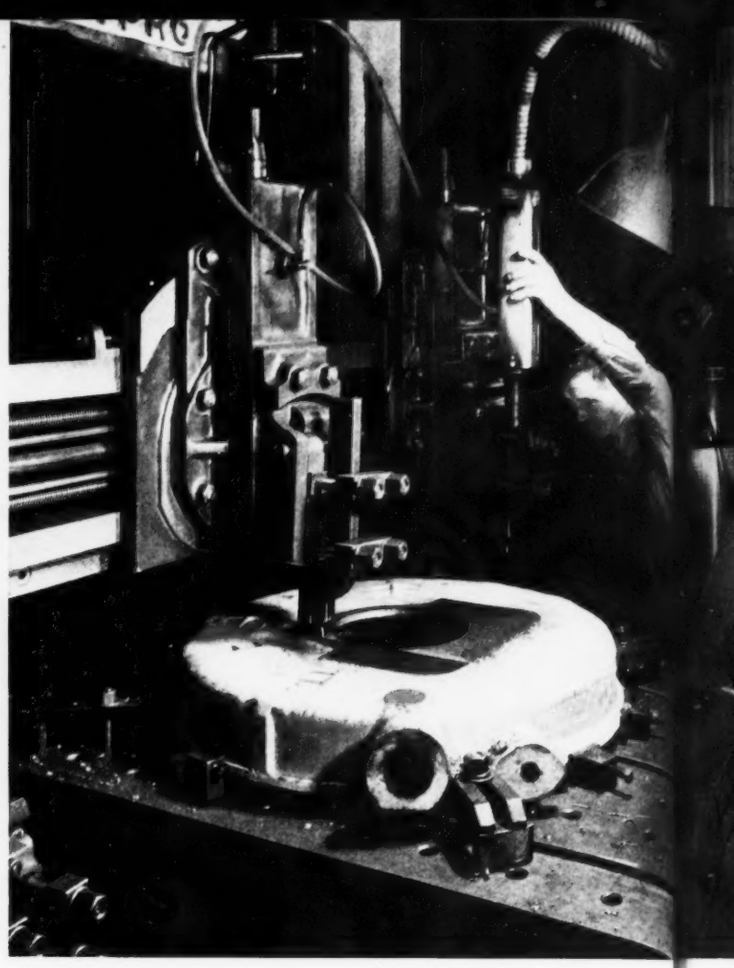




Several planing operations of unusual accuracy are performed in machining two bronze castings, about 7 1/2 feet in length, that make up the projectile-hoist housing for the gun mounts. The operation shown in Fig. 5 being performed on a Cincinnati planer consists of finishing the top and sides of a key that runs the full length of the projectile-hoist section, and also a groove of stepped cross-section on each side of the key.

In this operation, a cutter 3/8 inch wide is first used to rough-cut each groove to approximately its full depth. Then a cutter about 1 inch wide is employed to plane one side of the key and to cut the grooves to a greater width, in order to form a shoulder or step on both sides of each groove. Finally, a cutter 3/4 inch wide is mounted on the tool-head for finishing the bottom of the grooves. The width of the key must be held to limits of plus or minus 0.005 inch, but the total tolerance across the width of both grooves is only 0.005 inch.

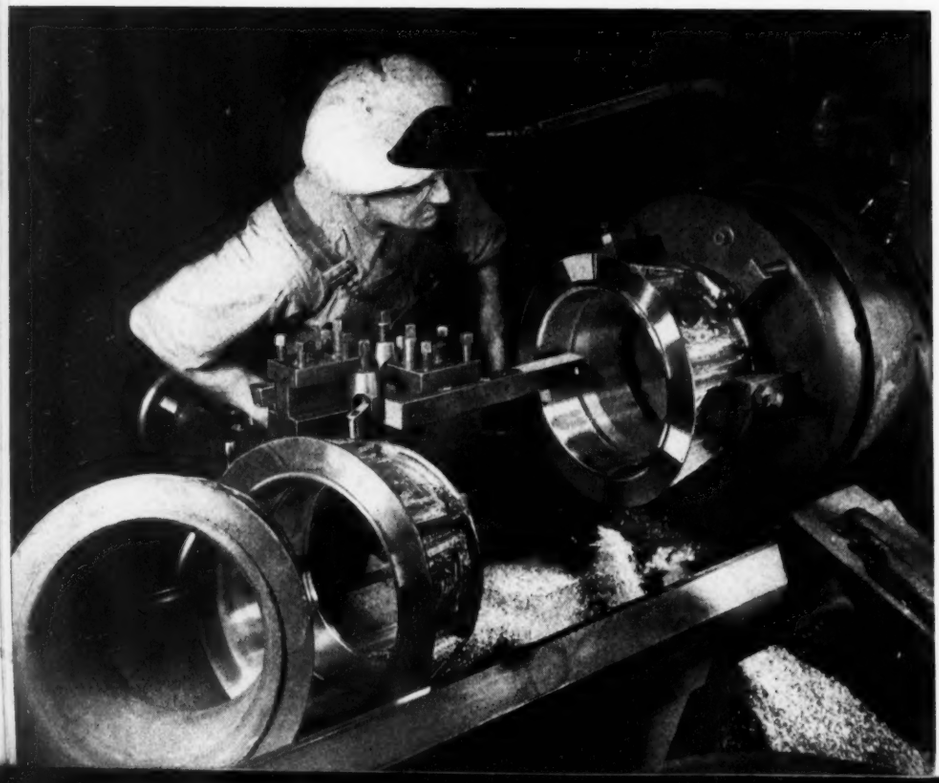
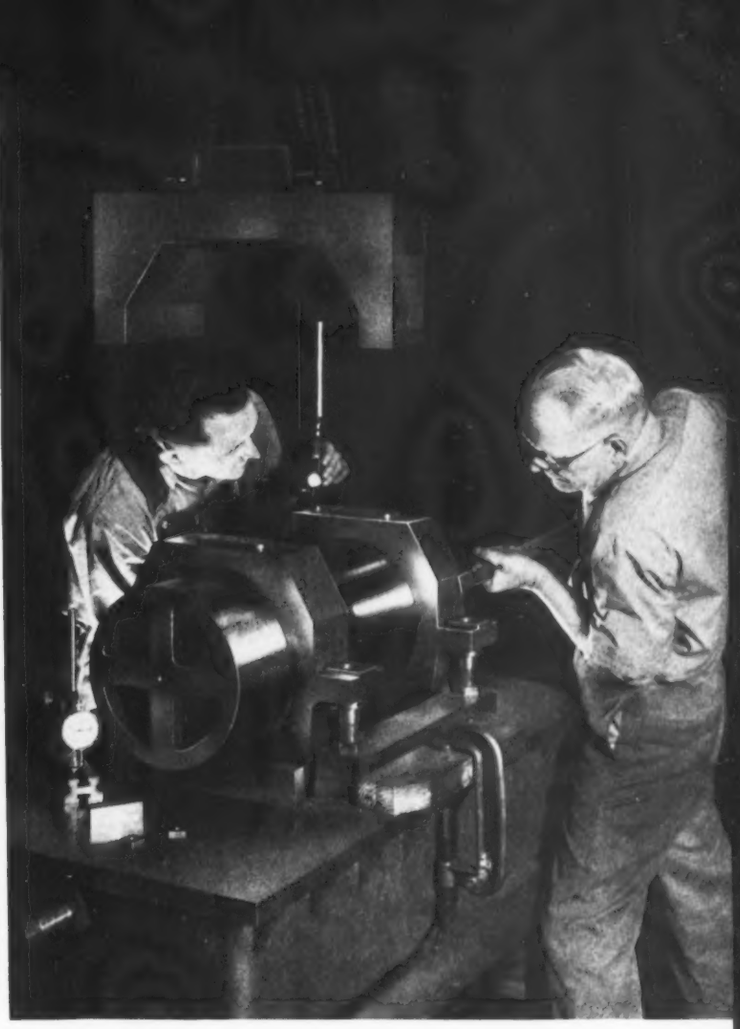


Fig. 5. (Above Left) Planing a Long Key and Grooves along Each Side of the Key on the Bronze Rear Section of a Projectile-hoist Housing

Fig. 6. (Above Right) Planing a Pad on the Top Side of a Cover for the Sight Housing in Accurate Parallelism with the Joint Face

Fig. 7. (Left) The Large Center-column Bases are Bored by Employing a Large Head on the Hexagon Turret of This Lathe, and Faced, Finish-bored, and Grooved with Tools on the Cross-slide



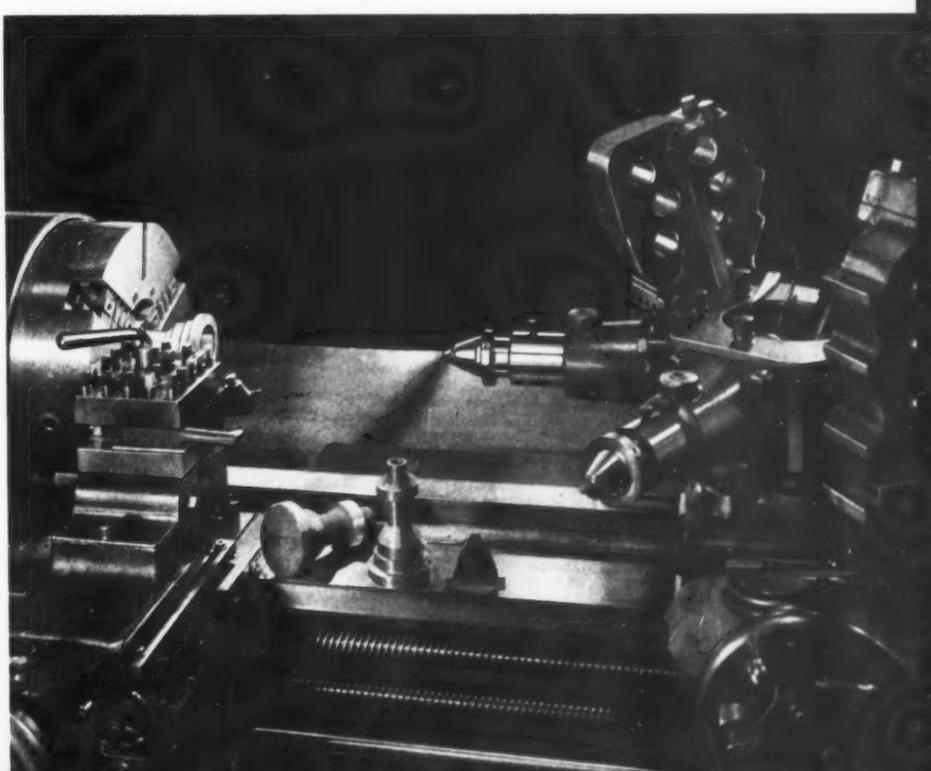
The projectile-hoist sections are next transferred to the Gray planer illustrated in Fig. 4, which is adjacent to the machine just used. As seen in the illustration, this planer is equipped with a special tool-head on the cross-rail by means of which two cutters can be used simultaneously for milling opposite sides of the casting to a radius. Each cutter is mounted in a circular holder which has worm-gear teeth around its periphery. In engagement with these worm-gears are two worms mounted on a horizontal shaft, one right-hand and the other left-hand. After each return stroke of the planer table and before the next working stroke, the operator turns a handwheel on the worm-shaft a slight amount, so as to feed each cutter a small increment around the circular path that it is cutting. With this tooling equipment, the rounded surfaces are machined simultaneously to the required radius within 0.005 inch.

Another planing operation in which accuracy is of considerable importance is illustrated in

Fig. 8. (Above Left) More than One Hundred Holes are Drilled and Spot-faced on the Rear Section of the Projectile-hoist Housing, and Many of the Holes are Countersunk and Tapped, by Employing a Radial Drilling Machine

Fig. 9. (Above Right) Scraping Trunnion Bearing Box Surfaces to Specified Dimensions within 0.0001 Inch

Fig. 10. (Right) Turret Lathe Operation in which the Work is Machined Inside and Out to Limits as Close as Plus 0.0003 Inch, Minus Nothing



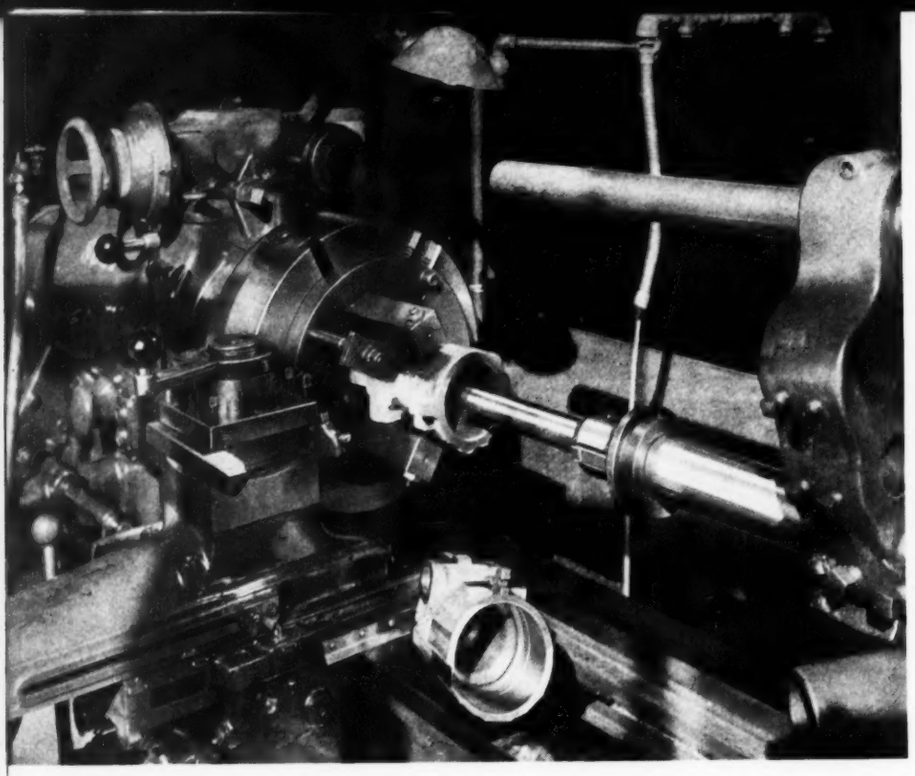


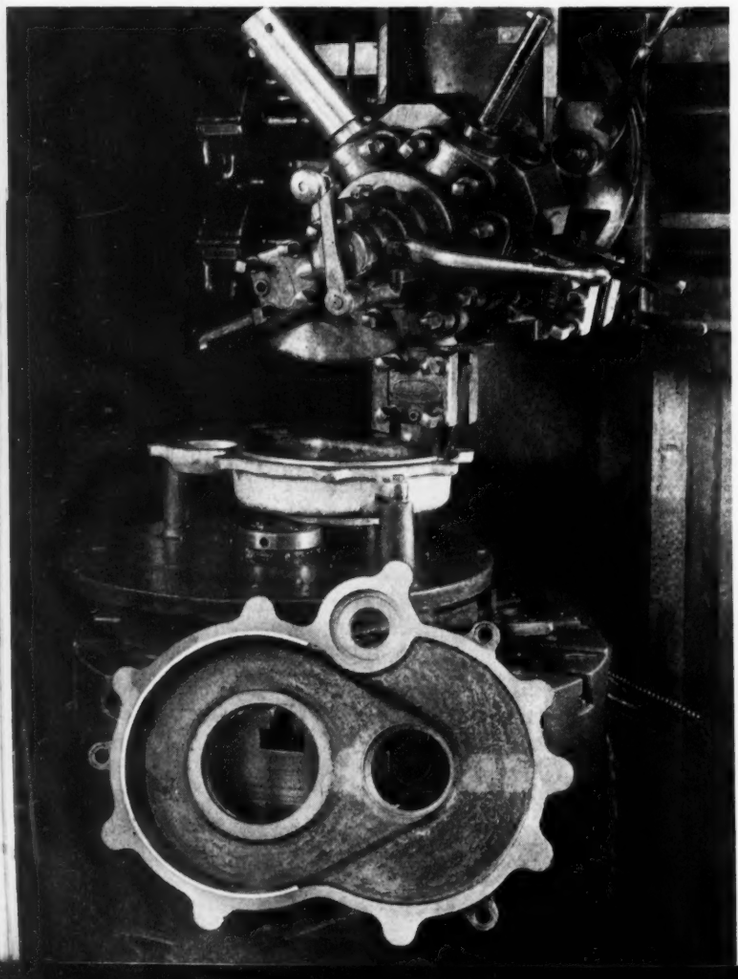
Fig. 11. (Left) Another Turret Lathe Operation, in which a Fuse Pot is Faced and Bored, the Bored Surfaces being Held within Limits of Plus or Minus 0.0002 Inch

VICTORY

Fig. 12. (Below) Vertical Turret Lathe Equipped with an Indexing Fixture which Enables the Work to be Revolved about Three Centers for Boring, Facing, and Turning

Fig. 6. This consists of planing a pad on the top side of a cover for the sight housing, and is performed on a Cincinnati Hypro planer. Several cuts are taken across the pad to bring the finished surface to the required height above the machined joint face of the casting within plus or minus 0.001 inch.

More than one hundred holes—134 to be exact—are drilled in the rear section of the projectile-hoist housing by means of the Carlton radial drilling machine illustrated in Fig. 8. All these holes are also spot-faced by substituting tools in the machine spindle, and about one-third of them are tapped and countersunk. At the time that the photograph was taken, the casting was clamped against the vertical faces of two brackets placed on the four large parallels with which the machine is provided. Many of the holes are machined, however, with the work clamped flat on the parallels.



The most exacting parts of comparatively large dimensions in the entire gun mounts are the trunnion bearing boxes, as most of the surfaces of these parts must be scraped to a specified tolerance. Two men work simultaneously on opposite sides of a pair of bearing boxes, as seen in the heading illustration and in Fig. 9. The boxes are mounted for the scraping operation on a large dummy plug which is a counterpart of the gun trunnion, so far as the diameter is concerned. All surfaces on the bearing boxes, except one of the angular surfaces, including the pads on the bolt lugs, must be scraped to size within 0.0001 inch. Both angular surfaces are, however, scraped.

During the scraping of the angular surfaces and the adjacent vertical surfaces, the accuracy of the operation is checked frequently by means of the templet seen in Fig. 9 suspended from a hoist. Templets of similar design are used for checking the top surfaces of the bearings and the finished bolt lug surfaces. Prussian blue is applied to the registering surfaces of the templet and red lead to the surfaces of the work being checked, so as to enable the high spots to be quickly located when the templet is lowered on the bearing boxes.

One of the heavier turret lathe operations consists of machining the bronze center-column bases, as seen in Fig. 7. In boring, the limits

Fig. 13. (Right) Face-milling Operation in which a Long Slender Part is Clamped between Adjustable Screws on the Under Side and a Long Bar on Top

VICTORY

Fig. 14. (Below) Vertical Turret Lathe Operation in which the Diameter of Large Trunnion Boxes Must be Held within Plus 0.0005 Inch, Minus Nothing

range from plus or minus 0.010 inch to plus or minus 0.020 inch, as a close fit with the mating part of these bases is not required. In the turret lathe operation on the bases, a rough-boring cut is taken by employing a large head mounted on the hexagonal turret, which was withdrawn from the work at the time that the photograph was taken. Tools on the cross-slide are then employed for facing the two flange surfaces and for turning a shoulder on the flange. Finishing cuts are next taken in the bore by a tool-head mounted on a long bar that is also held on the cross-slide, this operation being in progress in the illustration. Finally, three circular grooves are cut in the bore with tools on the cross-slide.

At the front of the Libby turret lathe in Fig. 10 are seen two small forgings, one rough and the other finished, which are fuse-pot plungers for the projectile hoist. In machining these forgings, the first step consists of drilling a 1/2-inch hole the full length of the part by applying a drill mounted on the hexagon turret. Two larger drills, also mounted on the turret, are next used for enlarging the hole at the cupped end, after which a live center on one of the turret stations is advanced to support the overhanging end of the work. Heavy rough-turning and facing cuts are then taken on the outside of the part with tools on the cross-slide.

The two cone-shaped reamers seen on the hexagon turret are next applied for roughing and finishing the conical seat in the cup end of the part to the outline of the gage that is resting on the ways of the machine beside the workpieces. Finishing cuts are then taken on the external surfaces of the part and the small-diameter hole is bored by employing tools on the cross-slide. One cylindrical surface which is machined to receive a ball-bearing race must be finished to the specified size within plus 0.0003 inch, minus nothing; other dimensions are held within plus or minus 0.0005 inch. The opposite end of the fuse-pot plungers is finished in the same machine with the cup end gripped in the chuck.

Comparable accuracy is necessary in machining the fuse pot. This operation is performed by the Gisholt turret lathe in Fig. 11. The first step consists of facing the end of the casting with a tool mounted on the cross-slide. Then

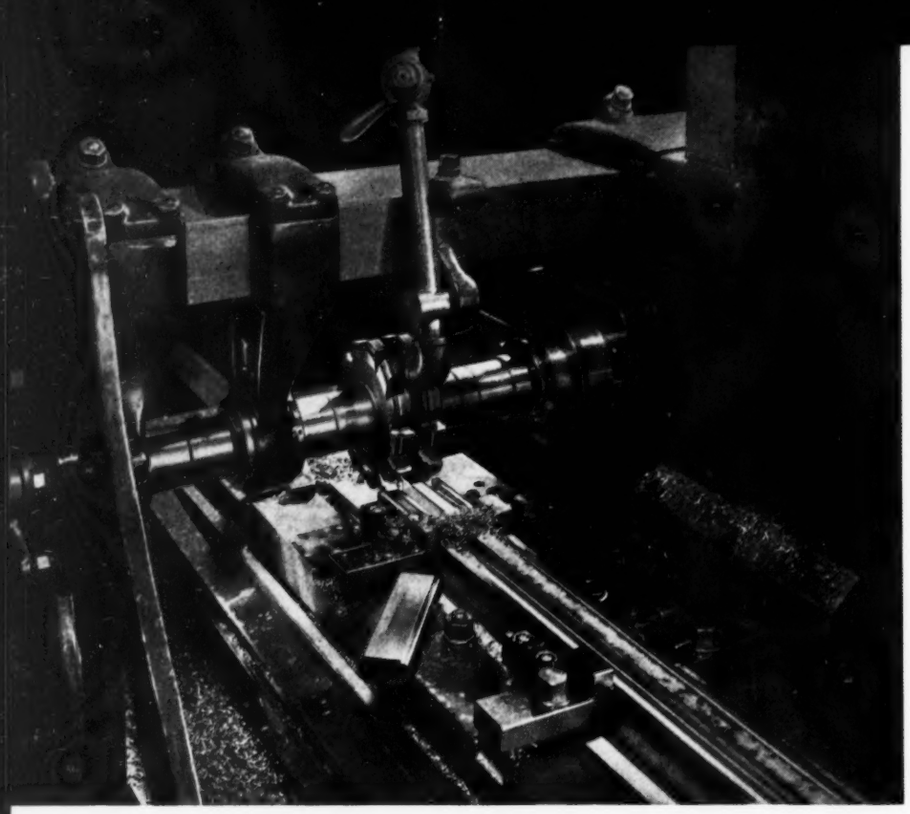


Fig. 15. Form-milling Operation in which Two Cutters Produce Stepped Grooves in One Side of the Chain-guide Rails

two Davis boring-bars on the hexagon turret are used in succession for rough- and finish-boring to two diameters. One of these cuts was in progress when the photograph was taken. A cutter mounted on the cross-slide, which is ground to the necessary contour, is next employed for machining a large round corner on the inside of the casting. Internal diameters must be held to size within plus or minus 0.0002 inch.

An important operation is being performed on a cover for the training gear by the Bullard vertical turret lathe seen in Fig. 12. The three larger holes in this part must be bored to center-to-center distances accurate within plus 0.001 inch, minus nothing, and the bore diameters must be within limits of plus or minus 0.0004 inch. At the time that the photograph was taken, the machine was engaged in turning a narrow shoulder that extends around somewhat more than half a circle at one end of the part. The cover is a steel casting and is annealed previous to machining.

The fixture is of an indexing type which enables the work to be revolved about any of the three bore centers. A plug which locates the fixture in the indexed position can be entered into bushings in the revolving member of the fixture, and withdrawn, by the operation of a lever. A large round nut in the center of the fixture is employed for locking the indexing member to the fixture base. The opposite side of this casting is finished on the same machine, using another work fixture.

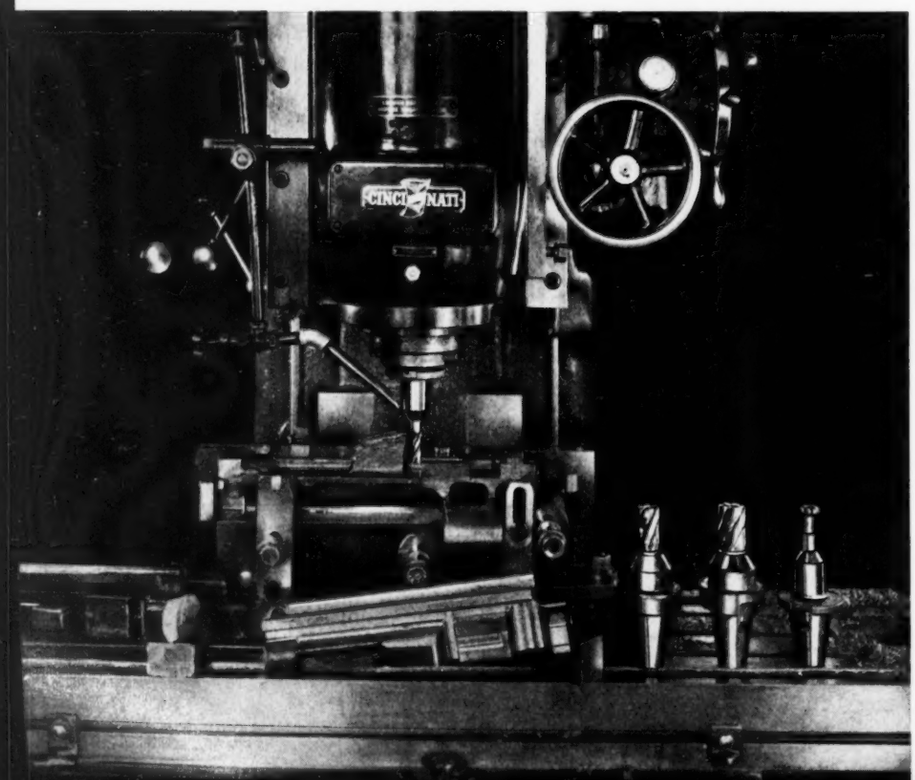


Fig. 16. Intricate End-milling Operation in which Surfaces are Machined to Limits as Close as Plus or Minus 0.0005 Inch

Another important job handled satisfactorily on a Bullard vertical turret lathe is the machining of the trunnion boxes. These parts have a bore approximately 10 1/2 inches in diameter that must be machined to size within plus 0.0005 inch, minus nothing. This operation, which is shown in Fig. 14, also includes facing the trunnion box sides, the thickness of the boxes being held to size within plus or minus 0.001 inch. Only finishing cuts are taken in the operation shown, the boxes being rough-machined before they reach the vertical turret lathe.

A Cincinnati duplex milling machine is shown in Fig. 13 engaged in milling opposite sides of the cast-steel chain-guide rails for the projectile hoist. This part is milled for a length of 51 inches, and its thickness must be within limits of plus or minus 0.002 inch for the full length. The under side of the rail is supported on blocks at the opposite ends and on three adjusting screws between the blocks. A bar of square cross-section that extends the full length of the piece is clamped on top to prevent any upward deflection of the part when the supporting screws are adjusted. The inserted-blade cutters are 8 inches in diameter.

Two grooves of a stepped design, that is, with shoulders running along each side, are milled in one side of the chain-guide rails to the contour of the "Go" and "No Go" gage seen in Fig. 15 lying on the table of the Sundstrand Hydro-Screw Rigidmil employed for the operation. Both grooves are cut at one time by form-milling cutters about 5 inches in diameter. Rough and finish cuts are taken, the finishing operation being the one shown in the illustration. The width across the step on each groove must be to size within 0.0025 inch, while the width of the key between the grooves must be to size within plus or minus 0.005 inch. Accurate location of the work is insured by registering the front side against hardened and ground blocks attached to the work fixture. Screws on the opposite side of the work hold it securely against these locating blocks. Clamps are provided on both sides of the fixture for holding the work down.

Limits as close as plus or minus 0.0005 inch are specified for many dimensions of the part seen in Fig. 16 at the front of the table on a Cincinnati vertical-spindle milling machine.

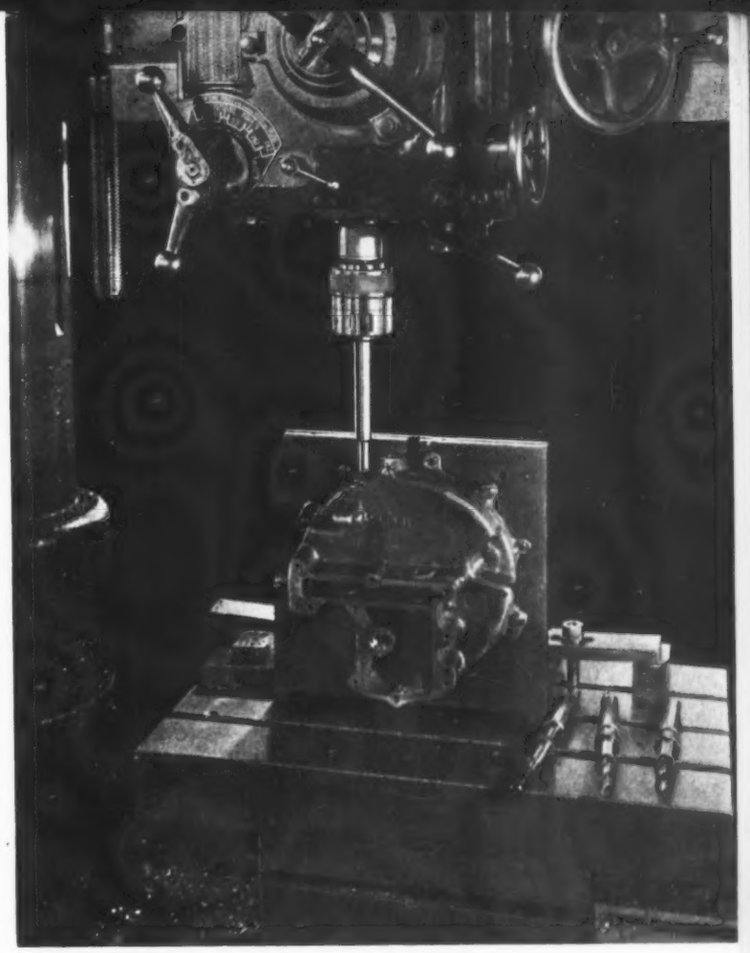


Fig. 17. (Above) Radial Drilling Machine Operation in which Drilling, Boring, Reaming, etc., are Performed on the Housing for the Foot-firing Mechanism

Fig. 18. (Right) Special Equipment Devised for the Accurate Drilling and Reaming of Seventeen Tapered Holes through Large Training Gears

This machine takes a large number of end-milling cuts in finishing this part. Several of the cutters are seen on the table at the right. Ordinarily, there is a plate mounted on the front of the fixture with hardened and ground surfaces that facilitate accurate setting of the cutters to the required heights before taking the various cuts. This plate was removed from the fixture at the time the photograph was taken to give a clearer view of the work and cutter.

Drilling, boring, reaming, counterboring, facing, tapping, etc., are performed on the housing for the foot-firing mechanism by the Carlton radial drilling machine illustrated in Fig. 17. The casting is of bronze. The holes produced range from 1/4 inch to 1 3/4 inches in diameter. The machine is shown equipped with a Precision universal offset boring head.

Special equipment devised for drilling and reaming holes between the teeth of the large training gears and completely through the gear section is illustrated in Fig. 18. This consists of an Ingersoll-Rand pneumatic drill and a fixture for accurately locating guide bushings for the drill. The fixture also supports the drill.

Two plugs on the fixture are located in tooth spaces to the right and left of the space in which the hole is to be drilled. These plugs position the drill correctly sidewise in relation to the adjacent teeth. The up and down location is obtained by clamping two fixture members against the upper and lower face of the gear. Feeding of the drill and reamer is accomplished by applying a small wrench to a screw that extends through the end of the fixture. The opposite end of this screw bears against the regular feed-screw of the drill.

Seventeen holes are drilled through the gear in this manner. A tapered reamer is then employed. The inside diameter of the gear, at the tops of the teeth, is almost 7 feet.

* * *

Machine Tool Production Reaches Billion Dollar a Year Volume

During the month of December, the machine tool plants of the country shipped $85,100,000 worth of machine tools, according to figures compiled by the National Machine Tool Builders' Association. This is the highest volume of machine tool output ever attained in one month. This monthly output is at the rate of over $1,000,000,000 a year. The output for the entire year of 1941 reached a value of $775,300,000. The production in 1940 was valued at about $450,000,000. It is estimated that the number of people employed in machine-tool building plants at the end of 1941 exceeded 110,000, compared to 78,000 in December, 1940.

High School Trains Electricians for War-Time Industries

Numerous public high schools throughout the country are now teaching subjects essential to war-time production. As an example may be mentioned the North High School at Binghamton, N. Y., where both regular and night school students are taught electrical work in a laboratory designed and equipped by the General Electric Co. This training room contains electrical machinery and instruments for making commercial tests and studying the operating features of various electrical apparatus. The equipment includes direct-current motors and generators, commercial transformers, instrument transformers, automatic controllers for both direct-current and alternating-current machinery, and a switchboard controlling the power used in the laboratory. Electrical measuring instruments are dealt with in detail in the course.

The studies are divided into three parts—a discussion of the theoretical and practical factors governing the construction and operation of the machine to be tested; performance of the test; and a thorough report on the test and its results. In the regular three-year technical course, each student is required to make nearly one hundred different experiments or tests, every one of which requires the use of some electrical instrument.

* * *

New Degreasing Agent

A new mineral grease and dirt-digestive solvent has been developed by the Curran Corporation, Malden, Mass., which is known by the trade name "Gunk X-11." This degreasing agent is available in the form of a concentrate which may be diluted with a grease solvent before being used to charge large open cleaning tanks or vats. It is said that the new degreasing process is superior to the trichlorethylene vapor phase metal cleaning method, which is an advantage at this time when there is a shortage of all chlorinated solvents. The new cleaning method is carried out by cold immersion of greasy or dirty parts. The process makes possible grease cleaning operations on a large scale with a comparatively small investment in equipment.

* * *

Orders received by the General Electric Co. during the year 1941 reached an all-time high. The value of the orders totaled $1,132,837,000, compared with $654,190,000 in 1940, which represents an increase of 73 per cent.

Machinability of Steel and Malleable-Iron Castings

By E. K. SMITH, Metallurgist
Electro Metallurgical Co., New York City

THE machinability of ferrous castings was discussed in an article published in February MACHINERY. The present article will deal with factors influencing the machinability of steel and malleable-iron castings.

The machinability of steel castings is quite a different problem from the machinability of gray iron castings, because of the ductility and strength of the steel. Steel requires a good deal more power for machining, and a complication is its tendency to "build up" on the cutting tools. Much research work has been done in an endeavor to determine the factors influencing the machinability of rolled steel, particularly during recent years. Fortunately, a great deal of the information obtained from this basic research can be applied to steel castings as well.

The effect of the more common elements, such as carbon and manganese, on the machinability of steel is generally known. Some mention should be made, however, of the elements added to improve the machinability of the austenitic steels of the 18-8 type, which have a strong tendency to work-harden and to "build up" on the tools.

Effect of Constituent Elements on Austenitic Steels

Selenium—Selenium is very effective in promoting machinability. Usually the phosphorus content is raised to about 0.10 to 0.15 per cent, and approximately 0.30 per cent selenium is added.

Sulphur—A high sulphur content is also effective in improving the machinability of stainless steel; usually about 0.30 per cent sulphur is added. From 0.15 to 0.30 per cent zirconium is often used to offset some of the adverse effects of the sulphur.

Columbium — Columbium is finding increasing use for fixing the carbon in stainless steel, and is said to have a beneficial effect on machinability.

Zirconium—Zirconium is widely used in promoting the machinability of the highly alloyed steels. Part of its effect is doubtless due to its action in slagging off abrasive particles which are detrimental to tool life.

Manganese — When both sulphur and manganese are on the high side, the manganese sulphide formed has a decidedly beneficial effect on the machinability of steel castings.

Bismuth — Very recent work indicates that the addition of small amounts of bismuth increases the machinability of stainless steels without any detrimental effects.

Effect of Other Factors on Machinability of Cast Steel

Usually steel castings are heat-treated in order to meet minimum physical requirements, but the specifications are so stringent that there is not much leeway left for heat-treatments to promote machinability. Many of the low alloy steel castings are given one or two normalizing treatments, followed by a draw. The resulting grain is rather fine, and probably is not so machinable as a coarser grain would be. A fairly coarse pearlite gives good results with the deep cuts and moderate speeds used.

In carbon-steel castings, the Brinell hardness number gives a fair measure of machinability. Although there seems to be a close relationship between hardness and machinability, complaints on difficulties in machining do not always mean that the metal is too hard. The author recalls one case, for example, where it was reported that machining operations disclosed large hard spots in castings of a high chrome-nickel type, and the tool would barely cut certain areas of the casting.

Examination showed that the metal had an extremely coarse grain, with large areas of different luster. A diamond point was run over different sections of the surface, but no appreciable difference in hardness could be ascertained. The conclusion was finally reached that all areas were of approximately equal hardness, but the difference in appearance of the machined surface was due to different orientation of the large grains.

Because of the high pouring temperature of steel castings, fused-on molding sand frequently interferes with machinability. This effect can be minimized by the use of a good grade of silica

sand and a bond with high melting point. A silica wash on the face of the mold is also advantageous. As a precautionary measure, it is best to take a deep first cut, so as to prevent the abrasion of tools by burned-in sand.

Effect of Various Deoxidizers on Machinability of Steel

It is believed that the hard type of inclusions frequently incorporated in steel castings reduce tool life appreciably. In the final deoxidation, considerable amounts of silica and alumina and other hard particles remain in the steel, resulting in abrasion of the tools. The amount of silica present can be greatly reduced by a preliminary addition of ferro-manganese as a first deoxidizer. Such addition tends to coagulate the extremely fine silica particles and remove them from the bath.

Some interesting experiments on the machinability of free-cutting steels killed with various deoxidizers may shed considerable light on the machinability of steel castings. One investigator, finding that machinability is decidedly affected by the type of deoxidizer used in killing the steel, points out that there is probably a relation between the hardness of the deoxidation products and the machinability of the steel. Relative machinability ratings are given in the accompanying table.

Cutting liquids are generally used on steel castings. When the metal is tough and deep cuts are indicated, a lubricating oil, with or without sulphur, may be used. When cuts are lighter and speeds higher, a soluble oil furnishes some lubrication and acts as a coolant; it also washes away the chips.

With the low-carbon steel castings, machining can be done at high speeds, using deep cuts. With the austenitic steels, slower rates are used, and with the high-chrome, high-carbon abrasion-resistant castings, even more moderate speeds are used. The austenitic steels can be machined at about three-fourths of the rate for carbon steel, provided selenium-phosphorus or high sulphur-zirconium combinations (or possibly bismuth) are used. The chrome steels containing from 12 to 16 per cent chromium, with moderately low carbon content, give little difficulty in machining.

A good many castings are being made which contain chromium in quantities ranging from 14 to 34 per cent, with carbon from 1 to 3 per cent, according to the service requirements. The hard high-carbon, high-chrome steels are being machined successfully with the cobalt type of tool, which is also used on austenitic manganese steel when machining operations are necessary. The first cut on the hard high-chrome castings is usually taken at about 15 feet per minute surface speed, and finishing cuts at 30 feet per minute. When extreme resistance to abrasion is required, the carbon content is raised to about 3 to 3.50 per cent. This results in massive chrome carbides which are resistant not only to wear, but to the cutting action of tools as well.

Machinability Ratings of Steels with Different Deoxidizers

Machinability Rating	Deoxidizer Used	
	Turning Operations	Drilling Operations
First	Manganese	Manganese
Second	Chromium	Chromium
Third	Silicon	Vanadium
Fourth	Zirconium	Zirconium
Fifth	Aluminum	Titanium
Sixth	Vanadium	Silicon
Seventh	Titanium	Aluminum

Machinability of Malleable Castings

Malleable castings are generally considered to be the most machinable type of ferrous castings. Their excellent machining properties are due largely to their structure, which consists of small nodules of tempered carbon which act as a lubricant, the matrix being ferrite. While there is a general agreement on the excellence of the machining properties of malleable castings as a whole, there is a definite lack of agreement on the relative machinability of the different types of malleable castings.

Some years ago, the standard malleable castings contained about 2.90 per cent carbon and 0.75 per cent silicon, with a tensile strength of 42,000 pounds per square inch and an elongation of 9 per cent in 2 inches. The demand for higher strengths and ductilities changed the composition to approximately 2.30 per cent carbon and 1 per cent silicon, with a tensile strength of 54,000 pounds per square inch and an elongation in 2 inches of 16 per cent or more.

At that time, some of the users complained that the new type of malleable iron was too "stringy" for quick machining, and the author ran a series of experiments with very crude equipment. Various types of castings were threaded and a drill penetration test was run. Observations were also made on the length of chip produced, etc. The author came to this conclusion: When speed of machining is of more importance than great strength, a metal of, say, 42,000 pounds tensile strength and 6 per cent elongation will give the best results. At a later date, Dr. H. A. Schwartz ran very comprehensive tests with excellent equipment, and came to the conclusion that the machinability of malleable castings is proportional to the carbon content, thus confirming the previous results.

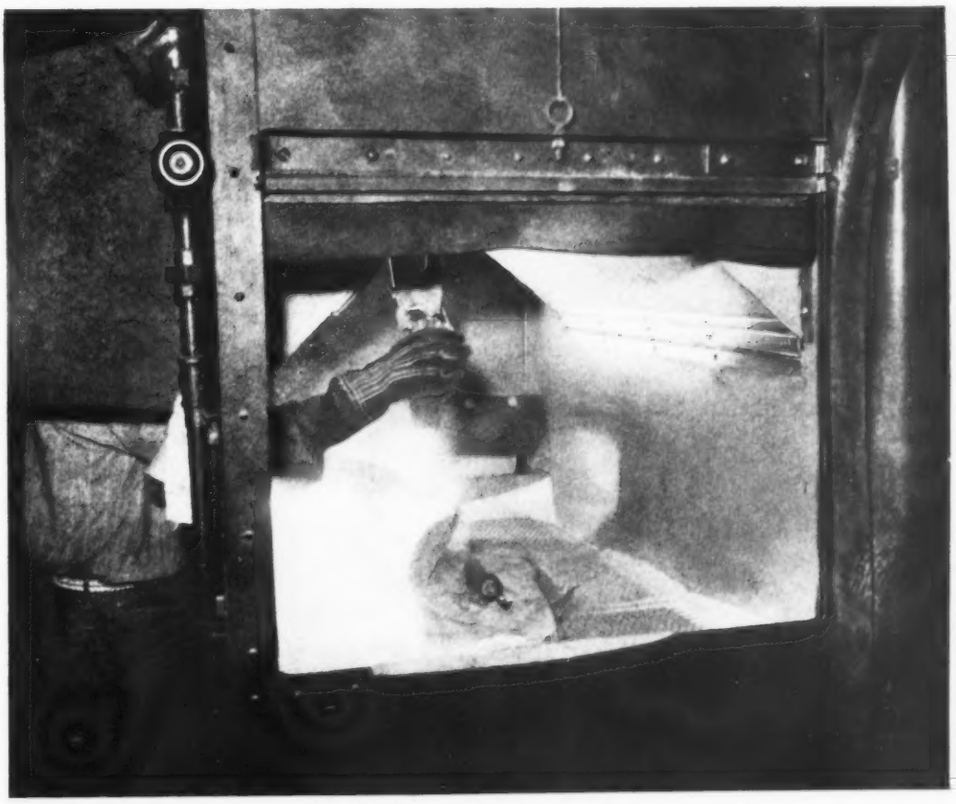
In production work on malleable castings, the author reached the conclusion that iron with approximately 50,000 pounds per square inch tensile strength and an elongation in 2 inches of 7 per cent gave maximum machinability. It is also believed that a malleable iron containing a small proportion of pearlite gives excellent machinability, coupled with a very smooth finish. It seems reasonable to suppose that castings with, say, 7 per cent elongation, would have less tendency to "gum up" on the cutting tool, than would the very ductile, strong malleable irons. The slightly lower strength and lower ductility tend to make the metal shear more easily, and thus promote machinability.

Most of the malleable castings contain relatively high proportions of sulphur, say from 0.060 per cent to 0.180 per cent, according to the process of manufacture, and as this sulphur is combined with fairly high manganese in the form of manganese sulphide, it seems reasonable to suppose that a part of the excellent machinability of malleable castings is due to the fragile and non-abrasive manganese-sulphide inclusions. These inclusions, of course, also help to break up the continuity of the matrix, so there is less resistance to the progress of the cutting tool as it severs the metal.

One of the difficulties experienced with malleable castings in the past has been the occasional appearance of a pearlitic rim. These rims seriously interfere with machining, but have generally been eliminated by better control of analysis and of annealing operations.

It goes without saying that the original hard carbides in the malleable white iron must be completely broken up in the annealing operation, in order to give good machinability. In some types of annealing operations, a fairly deep decarburized rim is produced, and this may give some difficulty in the first machining cut. This is doubtless due to the fact that the temper carbon has all been burned out from the outer surface of the castings, so that, in taking a light cut, practically pure silico-ferrite is machined, which is quite similar in its cutting characteristics to wrought iron.

Various types of lubricants are used on malleable iron, soluble oils or sulphide oils being common. Extremely high machining speeds can be used on properly made malleable castings. One large production shop, using a cutting liquid, is exceeding the following: Speed, 310 feet per minute; feed, 0.015 inch per revolution; and depth of cut, 1/8 inch. Another production shop is machining similar malleable castings at rates in excess of 400 feet per minute. It is highly probable that these cutting speeds and feeds for machining malleable castings will be greatly exceeded in the future.



Most Parts of the 20-millimeter Anti-aircraft Gun Manufactured by General Motors are Parkerized. Before that Operation, the Parts are thoroughly Sand-blasted in a Pangborn Machine. A Typical Sand-blasting Operation is Shown in the Illustration

Engineering News Flashes

Giant Print Developer Speeds Defense Output

What is believed to be the largest print developing machine of its type in industry is turning out 18,000 prints daily at the East Pittsburgh works of the Westinghouse Electric & Mfg. Co. These drawings or prints are produced by a method known as the "black and white direct printing process." The 80-inch machine produces prints in black lines on white paper, developing more than 10 miles of 36-inch wide paper per month.

Recently the United States Navy shipped destroyer equipment tracings to East Pittsburgh with rush orders for 553 prints ranging from 13 to 25 feet in length. The prints, weighing 200 pounds, were ready for shipment in 24 hours.

Only 50 seconds is required to expose and develop a print. The machine uses only two gallons of water a day and is economical in floor space, power consumption, and operating costs.

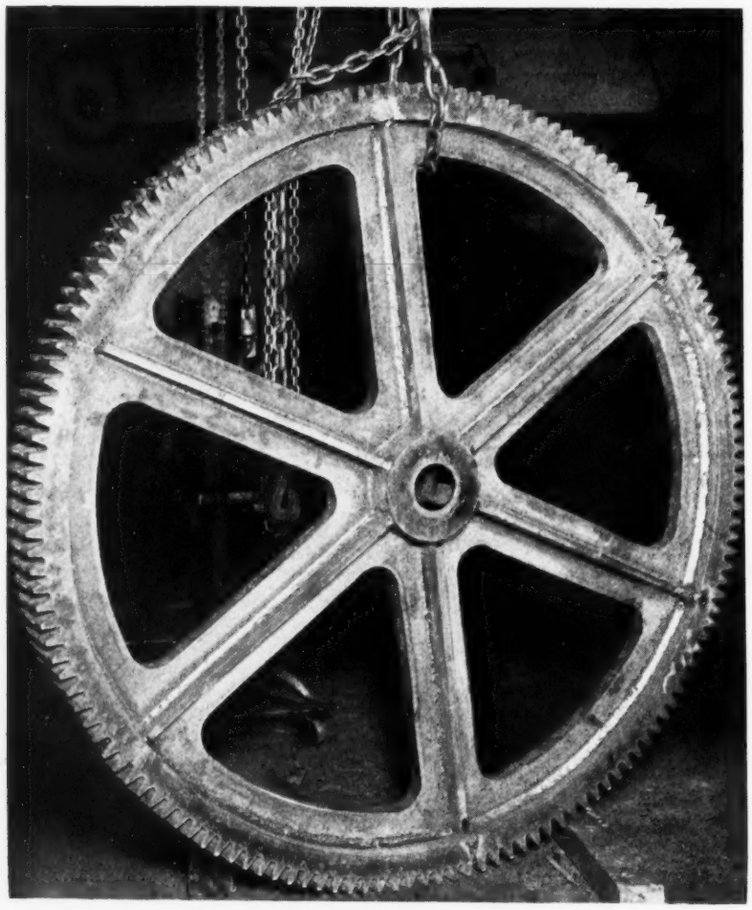
Automobile Engines for Marine Propulsion

A unique application of automobile engines for marine propulsion is being developed in a Gulf Coast shipyard, where batteries of automobile engines are used for propulsion instead of the more expensive marine engines ordinarily employed. Furthermore, automobile engines can be delivered much more quickly than ordinary marine engines.

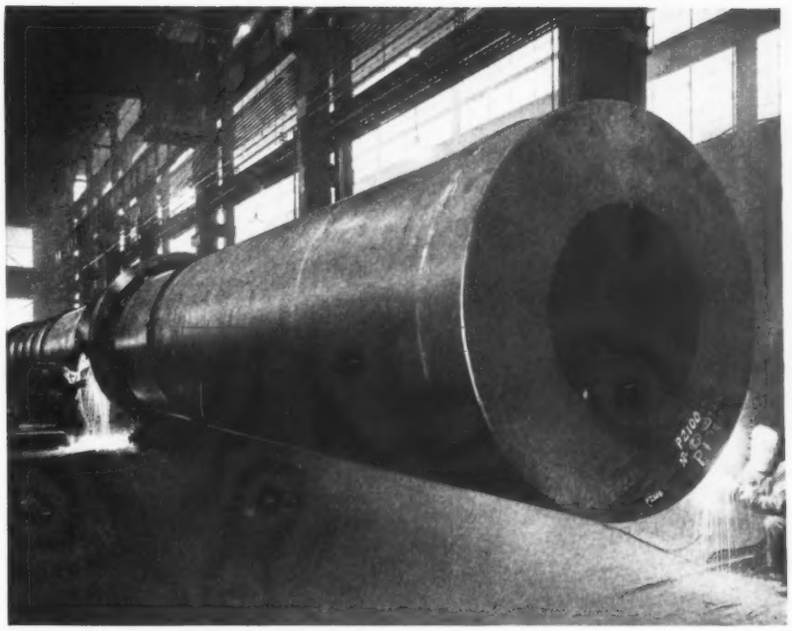
Rubber in Cellular Form Utilized as Heat Insulation

Cellular rubber, a new material of high heat insulation value, which will be marketed under the trade name "U. S. Royal Insulation Board," has been developed by the U. S. Rubber Co. The term cellular is descriptive, since the material actually consists of a thin external dense layer enclosing microscopic cells of nitrogen gas in a matrix of rubber. The material is twice as light as cork.

The heat transmission or "K" value (B.T.U. per hour per degree F. temperature difference for a specimen one foot square and one inch thick) of cellular rubber is 0.237, which is lower than that for any of the thirty-seven types of heat insulation listed in the United States Department of Agriculture Handbook dated November 2, 1939.



A 6-foot, Cast-iron Punch Press Gear that Recently Failed was Replaced in Twelve Hours with the Aid of a General Electric Alternating-current Arc Welder. It would have Taken at Least Forty-eight Hours to Obtain a New Casting for the Gear, Assuming that the Pattern was Available. The Complete Cost of the Arc-welded Gear, as Supplied by the Menna Welding Co., Toledo, Ohio, was Less than $300—a Saving of $100, Compared with the Cost of a Cast Gear; also the Losses Due to a Long Shutdown were Avoided



This is Not a Forging for a Giant Gun, as No Big Bertha ever Dreamed of Could Match in Size the 9-foot Diameter of This Paper Mill Rotary Kiln, 170 Feet Long, which is being Welded in the Milwaukee Shops of the Allis-Chalmers Mfg. Co.

The new rubber material is moisture-resistant, rot-proof, oil-, acid-, and fire-resistant, and has good structural strength, long life, resistance to vermin and termites, and good workability. Two weights of the insulation board are to be manufactured, only the lighter of which will be fire-resistant. The weights are 4.5 and 5.5 pounds per cubic foot for 1-inch thick material. The lighter weight material will withstand a load of 22 pounds per square inch without crushing, and the heavier material a load of 35 pounds per square inch. The boards can be cut to shape with a band saw or power saw, and surfacing can be done with a planer. The material is thermoplastic, and hence can be shaped when heated to a temperature of 190 degrees F. or higher.

Besides its importance in the building field, the new material is being used in war work for heat insulation under the decks of mosquito type torpedo boats, and also in supports for self-sealing gas tanks in airplanes.

Wireless Conversations with Portable Radio Telephone

A portable, self-contained radio telephone consisting of transmitter and receiver, and weighing only 4 pounds, has been developed and placed on the market by the Communications Division of the Weltronic Corporation, Detroit, Mich. This equipment, known as "Trans-Ceivers," can be operated either in pairs or as group instruments in combination with a central receiving station which may be connected to a loud-speaker unit. When used in pairs, the Trans-Ceivers are tuned to the same frequency. When used with a central receiving station, the portable equipment and the central station are tuned to the same frequency.

These radio telephones have a range of upward of a mile on land, assuming that there are normal obstructions by buildings or other objects. In open country, or where there are no obstructions, as between an airplane and the ground, the range may be as much as five miles. All the power required by the Trans-Ceivers is contained within the unit in the form of standard dry batteries. A collapsible fishpole type of antenna is provided to increase the range of operation.

Largest Industrial Rubber Tire Carries over Seven Tons

What is believed to be the world's largest industrial truck tire, capable of carrying more than 7 tons, was recently produced by the B. F. Goodrich Co., Akron, Ohio. Including the single-flange steel base to which it is bonded, the tire weighs 206 pounds. It is designed for use on industrial fork and ram trucks in steel mills. The tire has a rated capacity of over 7 tons at speeds of from 8 to 22 miles an hour. The overall diameter is 22 inches; the width at the steel base band, 16 inches; and the diameter of the wheel on which it is used, 16 inches.

Tank Cars Built from Welded Stainless-Clad Steel

What is believed to be the first tank car in which the tank is constructed entirely of welded stainless-clad steel has just been completed by the General American Transportation Corporation at its Sharon, Pa., plant. The tank required 15,000 pounds of "Silver-Ply" stainless-clad steel, supplied by the Jessop Steel Co., of Washington, Pa. Use of stainless-clad steel in this equipment will prevent contamination of the contents of the tank.

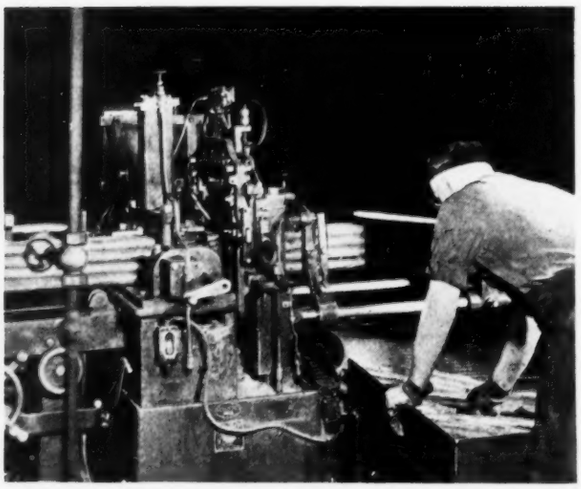


Fig. 1. Automatically Operated Power Hacksaw which is Used for Cutting Bar Stock to Predetermined Motor-shaft Lengths

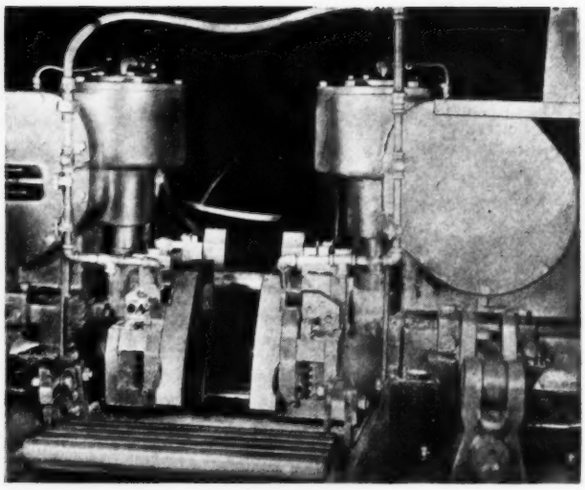


Fig. 2. Machine that Simultaneously Mills Rough Shafts to Length, Cuts a Driving Slot in One End, and Centers Both Ends

Developing an Efficient Procedure for Machining Motor Shafts

By C. J. ANDERSEN, Assistant Supervisor
Tool and Methods Section, Motor Department
General Electric Co., River Works, West Lynn, Mass.

THE motor shaft, though a comparatively simple component of an electric motor, becomes very important in these days, from the manufacturing point of view, because of the quantities of these shafts required to keep the wheels of industry turning. Therefore, in the course of periodically reviewing our manufacturing methods to see if improvements were possible, the equipment required for machining this part was given special attention. This was done, first, because of the output required and the constant increase in the variety of applica-

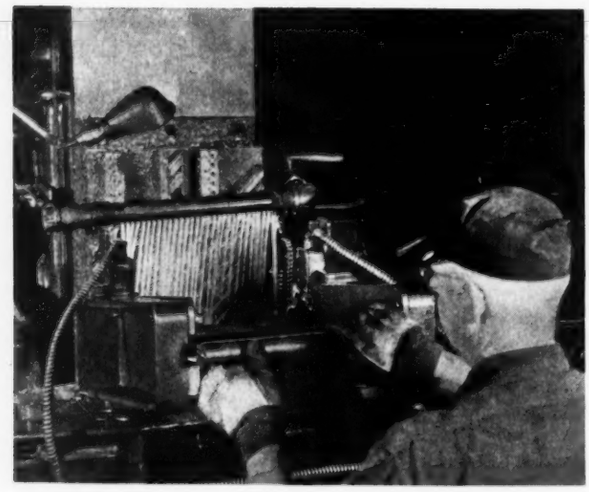


Fig. 3. Instead of Turning the Shafts, the Rough Bars are Surface-broached. This Provides the Required Shoulders

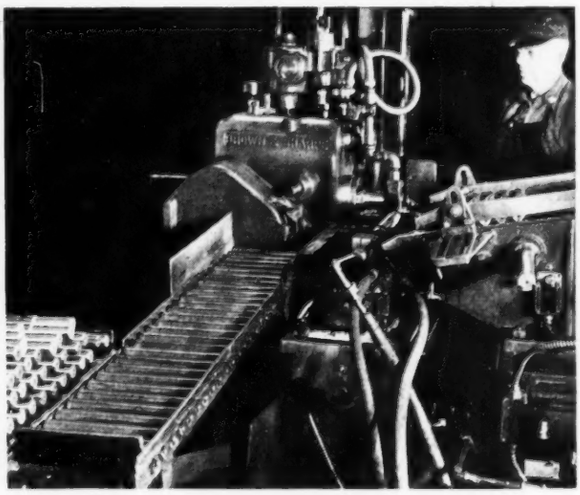


Fig. 4. In This Machine Keyways are Milled in the Shafts Automatically, the Attendant Simply Loading the Magazine

tions; second, because of the necessity for prompt delivery; and, third, because improvements in the quality of standard shafts, especially for the Tri-Clad motor development, were considered desirable.

After a thorough study, we divided our whole production of motor shafts into two general classes: (a) All shafts, regardless of type, that were made in sufficient quantities to justify a radical change in method of manufacture, thereby making possible substantial improvement in machine tool utilization and, consequently, shorter delivery schedules; and (b) all others, made in irregular or non-repetitive lots, where volume or special application did not justify expensive tooling or involved set-ups, but on which high quality and short deliveries were still a vital necessity.

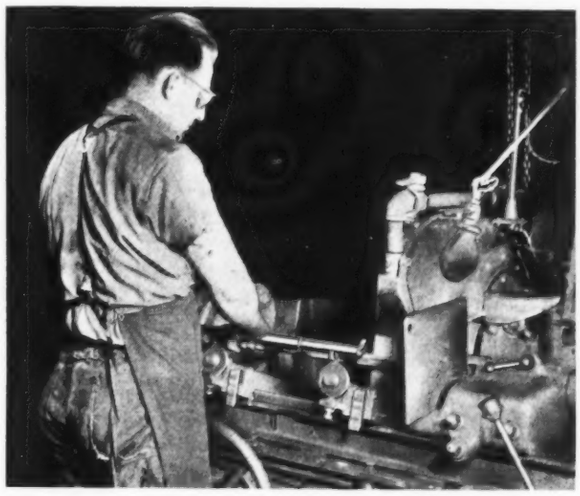


Fig. 5. Finish-grinding the Shafts on All Surfaces in a Semi-automatic Cylindrical Grinding Machine

Fig. 6. Special and Small-lot Shafts are Rough-turned on Electrically Operated Semi-automatic Lathes

While it is obvious that a simple solution of this problem would have been to replace the present equipment, machine for machine, where necessary, such a solution would only reduce the processing time in proportion to the possible increase in the utilization of tungsten-carbide tools. Therefore, in planning an improved method, our objective was primarily to accomplish the following: (a) To reduce the operator effort, not only per piece, but per day; (b) to make it easier for the operator to control quality —that is, accuracy and finish; and (c) to reduce the necessity for continuous operator attendance —that is, make it less necessary for the operator to be at the machine and constantly on the alert to make adjustments at exactly the right time to maintain the output.

In other words, we endeavored to provide an automatic closed-cycle machine for each operation; automatic means of controlling the size and accuracy for each machine; and automatic work-handling means for each operation.

In reviewing our particular manufacturing problem, we arrived at the conclusion that for the large-volume repetition work, we should strive to obtain equipment that would give us the shortest over-all process time consistent with good quality. The result of the study was an entirely new method of shaft manufacture, in which the work is processed through the several operations from the bar stock to the finish-ground product completely automatically, the human element being required only for the loading and unloading of the magazines, once the set-up is completed.

This method, which is now in successful operation, gives a magazine-loaded, automatically manipulated, intermittently attended machine operation, in which sizing, finish, productivity, etc., are controlled electrically by the machine after they have once been predetermined for each shaft.

With the recent introduction of the new Tri-Clad motor, the change-over from the former methods to the new were comparatively easy, because the tools could be designed from the start to suit the new method.

The expense might be considered a great objection to a process set-up of this kind, since the original or first cost is high; but with proper attention to the details of basic tool design, any shaft produced in lots of a few hundred can be economically made by a process set-up such as that illustrated here.

Surface broaching, which is the most involved operation, simplifies the problem of oil-grooves,

under-cuts, etc., whereas conventional turning of such surfaces is usually a costly operation.

The machines shown in the accompanying illustrations are grouped in a circle, about an oval-shaped gravity conveyor table for convenience in moving the partly processed shafts from one discharging platform to the next loading station. One operator is required to service the complete group, although, of course, a set-up man is employed for change-overs from one size to another. All set-ups can be made in a minimum of idle machine time, using pre-positioned cam bars, dogs, etc.

The studies of the procedure involved in the manufacture of our great variety of motor shafts showed that most of the time spent in producing small lots was occupied by the operator in measuring, cutting-and-trying, and inspecting his product. Therefore, in planning an improved method for small lots, our objective was to procure a lathe so designed that the operator could quickly pre-set length and diameter stops, with the expectation that the first shaft turned, using these stops, would be within the desired limits without "cut-and-try." Our objective was to obtain this accurate turning at maximum cemented-carbide cutting tool speeds and feeds.

As shown in Fig. 6, this has been satisfactorily accomplished with an electrically operated, semi-automatic, single-tool, step-turning lathe, necessitating no special tooling or exceptional skill. Each operator is furnished with a complete set of gage-blocks for controlling diameters and length between shoulders. These blocks are quickly interchanged in the longitudinal- and cross-feed stop-dogs, requiring a minimum of set-up time.

Powder Metallurgy Assumes an Important Role

THE following information relating to new developments in powder metallurgy have been obtained from the Moraine Products Division of the General Motors Corporation. A pioneer in the field of powder metallurgy and long a producer of bronze bearings made from mixtures of powdered copper, tin, and graphite, the Moraine Products Division two years ago began to make similar bearings and other parts from iron and graphite. Manufacturers of army trucks and navy Diesel engines, among others, found these bearings a decided improvement over the more expensive parts used previously. In structure, they were similar to high-carbon steel.

Originally, the iron powder, which was compressed and heated to form gears and bearings, was obtained from a special sponge iron imported from Sweden in raw form, just as it came from the mine. Today, this powder is produced from domestic sheet-steel scrap.

Powder metallurgy was discovered more than one hundred years ago as a means of working platinum. However, as furnaces improved, the method was discarded. It was revived only when tungsten began to be used for electric light filaments. The modern industry is an outgrowth of this electrical application.

There are four major steps in the production of powder metal parts: The first is the mixing of the ingredients. The second is briquetting or molding in dies of the required shape under extremely high pressure. In some cases, the pressure is as high as 100 tons per square inch. After briquetting, the part has a mirror polish and looks like a finished product, but it can be crumbled with the finger. The third step is sintering—heating the bearing to a point below the melting point at which it still retains its shape but at which the particles of powder become fused or welded. The fourth or final major operation is finishing the bearing. The methods of finishing vary, depending on the tolerances and other factors. In some cases, no additional work is required except impregnation with oil. In other cases, the parts must be sized, sometimes ground, and sometimes burnish-broached.

The outstanding feature of powder metallurgy is that its products can be given almost any desired degree of porosity. They can be made to absorb lubricants or serve as filters or separators for liquids or gases. Thin strips of powder metal can be used to bond other metals together.

A typical application of powder metallurgy is an oil-pump gear which was used to replace a cast-iron gear. The latter had to be machined from 0.8 to 0.28 pound, each tooth having to be cut. The powder iron gear requires almost no machining, leaves no scrap, and results in quieter operation.

* * *

A Suggestion for Factory Blackouts

The following method for a blackout procedure has been suggested. First, paint windows with black paint; then apply to the window panes No. 222 blackout glue, made by the Midland Glue Products Co., Detroit, Mich., and attach to the pane waterproof paper, cardboard, fiber, or similar material. In this way, not only blackout but also a shatter-proof glass will be provided in the event of bombings.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Pump with Flexible Rubber-Tube Action

A pump designed to isolate the liquid or gas being pumped from the pump mechanism itself is a recent development of the Downingtown Mfg. Co., Downingtown, Pa. The operation of this pump, which is known as the Downingtown-Huber Squeegee type pump, is based upon the alternate squeezing and releasing of a rubber tube by a rocking compressor ring.

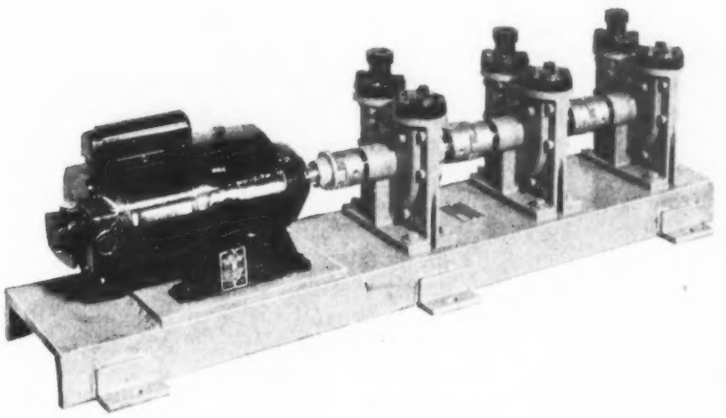


Fig. 1. Three-in-line Tandem Arrangement of Pump Units Having Flexible Rubber-tube Action

As shown in the diagram, Fig. 2, the pump consists of six main parts. To the drive-shaft in the center is keyed an off-center rotor. This, in turn, can be keyed in any one of three positions to an adjustable eccentric. (In both diagrams the rotor is shown keyed in the central position.) The shaft, off-center rotor, and adjustable eccentric rotate as a unit in the compressor ring, and impart a rocking action to it. This rocking action pushes the compressor ring out radially against the tube and continues progressively along the curved portion of the tube until it approaches the discharge end, when the tube is released and compression begins again at the intake end. Two stages of this action are shown in Fig. 2. Compression of the

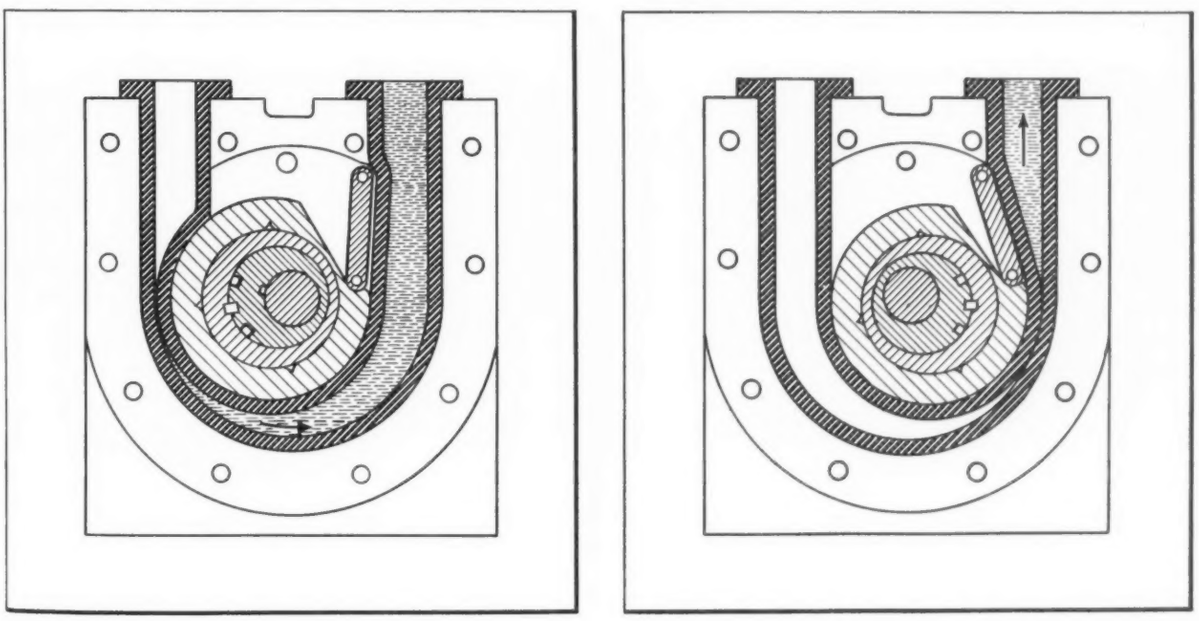


Fig. 2. Diagrams Showing Two Stages of Operation of Squeegee Type Pump in which Rotating Eccentric Member Forces Liquid in Rubber Tube from Inlet to Outlet

tube in this manner advances the liquid or gas being pumped toward the discharge side, while expansion of the tube back to its normal diameter produces a vacuum drawing more liquid or gas in from the intake side. A tube guide plate attached to the discharge side of the compressor ring prevents expansion of the tube beyond its normal diameter at this point where the tube is not surrounded by the pump housing or the compressor ring.

Thus, the liquid or gas being pumped is totally enclosed within the tube while passing through the pump. The tube itself can be made of pure gum rubber and various acid and oil resisting synthetic materials; in addition, it can be lined with synthetic materials for corrosion resistance or to prevent contamination. Solutions containing solids, whether abrasive or otherwise, cause little wear, as the inside of the tube is a smooth, continuous surface. The compressor ring merely rocks against the tube without any rubbing action, and hence causes practically no wear. A new tube is readily installed by simply fitting it inside the housing which forms its support and backing.

This pump is available in a fractional gallons per minute size which has a capacity range of from 0 to 6 gallons per hour, and develops a lift of 25 feet and a discharge pressure of 25 pounds per square inch. It weighs 3 pounds in a bronze housing, or 1 pound in a plastic housing. In the larger sizes, the capacities range from one-half gallon per minute up to 50 gallons per minute in the single-stage type, and up to 100 gallons per minute in the double-stage type.

* * *

Rolling Double-Fold Seams on Ventilator Ducts

A double-fold seam is formed along the edges of thin sheet metal used in the construction of ventilator ducts at the shipbuilding yard of the Cramp Shipbuilding Co., Philadelphia, Pa., by means of the Whitney-Jensen rolling machine here illustrated. The seam is formed completely along one edge of the metal in a single pass through the seven sets of rolls. Edges are being rolled on material up to No. 18 gage at speeds as fast as 30 feet a minute. Rolls can also be mounted on the opposite ends of the roll-carrying shafts, so that the two sides of the machine can be used simultaneously.

Small Rolling Machine Employed for Forming Locking Seams on Sheet-metal Pieces Used in the Construction of Ventilator Ducts for Installation aboard Ship

* * *

Wet Belt Grinding

Belt grinding is today replacing many milling and grinding operations, and is supplementing operations performed by other machine tools. Recently, a new method of belt grinding known as the "wet belt process" has been introduced for use on both metal and plastic parts. When grinding by the wet belt method, the danger of heating, discoloring, and warping is eliminated. The presence of dust is minimized, and inflammable materials can be handled without fear of ignition. According to the Porter-Cable Machine Co., Syracuse, N. Y., builder of both wet and dry belt grinding equipment, the belt life is also greatly increased, because the belts are continuously washed and kept free from clogging, especially when grinding soft metals.

What the Product Designer Should Know About Plastics

Characteristics and Application of Plastics, and Directions for the Design of Plastic Molded Parts for Economical Quantity Production—First of Five Articles

By ERIK FURHOLMEN, Chief Estimating Engineer
Chicago Molded Products Corporation

PLASTICS, as now generally defined, are materials capable of being formed under heat and pressure in steel or similar molds. These materials are chiefly organic and synthetic. There are often added to plastic materials non-plastic fillers, such as wood flour, asbestos, cotton-flock, and the like. The resulting mixture is lower in cost and frequently produces a stronger product than if no filler were used. When a mixture of this kind is molded, the plastic acts as a binder which causes the molded piece to retain its shape. Coloring matter is usually added to the plastic whether a filler is used or not.

Plastics for molding are commonly furnished as dry powders or granules; but when softened by heat—that is, "fluxed"—they take the form of the mold cavity and, when properly "cured" or set, are ejected. In general, little, if any, finishing is required to make the moldings ready for use. The molds are, of course, "permanent" and generally, hundreds of thousands of parts can be produced in the same mold without its wearing out, unless the materials to be molded are extremely abrasive or require exceptionally heavy pressure (or both), or unless the mold has fragile moving parts or is unusually complicated. In designing a mold that is subject to excessive wear or breakage, due consideration should be given to the easy replacement of the parts that are likely to wear or break. Molded plastics are gaining rapidly in importance to industry, and they are steadily finding new applications.

A designer considering plastics for his product has a wide choice, as the properties of different plastics vary greatly; but, of course, any one material may not possess all the required properties. To make sure that the plastic best suited for the particular product is chosen, it is well to consult a good custom molder or a plastic material supplier before the design is too far advanced.

Molded products are not only desirable for numerous applications, but are demanded by the trade in many cases, partly because of the endless variety of shapes into which they can be molded. Few materials excel plastics in respect to appearance. It is possible to have anything from a "soft" matted surface to one of glistening polish. The colors are practically unlimited and are generally fadeproof, although some materials are subject to fading or other color change. Contrasting colors can be secured either by external application of paints or by molding different parts in different colors for later assembly. Combination with metal parts also affords desirable contrasts.

Among the reasons why plastics are growing in favor is their pleasant "feel." This is due to their being poor conductors of heat, and because they are so readily molded with smooth surfaces and in shapes that fit the hand. This is an important consideration for the countless articles that have to be touched or handled. Growth in the use of plastics is attributable in part to a more general appreciation of their utility and to the economy with which they are converted into diversified forms. The choice of available materials is constantly increasing, and costs are being lowered both through reduced prices of these materials and by the adoption of more rapid and less costly molding procedures.

Reasons for Choosing Plastics

There are many reasons for the preference of plastic moldings today; outstanding among these are the following:

1. Plastics are converted rapidly and economically into an almost unlimited variety of shapes, many of which cannot be made so readily by most other methods of production. "Streamline" and other shapes having "clean" and attractive appearance are produced without difficulty and often in a single piece, whereas most other methods of fabrication require more parts, more operations, or both.

2. Many plastics possess transparent or translucent qualities coupled with lightness and strength, qualities seldom found in other materials and important for many industrial products.

3. The color range is unexcelled, the choice of colors available being sufficient to meet almost any requirement. Not all colors, however, are available in every kind of material, and not all have the same degree of color-fastness.

4. Practically all plastics have excellent insulating qualities, both electrical and thermal, and often can serve not only as insulators, but also as structural members, which, if desired, may be quite complex in shape.

5. In general, production is relatively rapid and can be in multiple when, as often happens, this results in increased economy. The material cost per piece is moderate, and parts can often be produced more economically than if fabricated by other methods. This is especially true when the finishing operations usually required on metal parts are considered. As a rule, the removal of flash or gates, or both, on molded parts, is a rapid and inexpensive operation.

Dimensional Limitations

Within certain size limitations, a large proportion of parts that can be cast in sand or in dies can be molded of plastics, provided the plastic chosen has the required strength and other necessary properties. If, however, cores must be used, they must not be fragile and must be of such shape as to permit of ready withdrawal from the molded part, so as to remain intact for subsequent use.

Plastics lend themselves most economically to the molding of relatively small objects having thin walls of fairly uniform sections. Any great departure from this slows up the operating cycle, and causes considerable increase in the cost of the piece. The maximum size of piece that it is practical to mold is not definitely fixed, but depends in part upon the size of press equipment available. Few parts larger than good-sized table type radio cabinets are in extensive production at present. A case, housing, or similar part becomes relatively expensive if its length exceeds 18 inches or if its width and depth are approximately more than 12 inches. If the wall thickness exceeds 5/16 inch, the curing time becomes so long that the expense is further increased. This refers particularly to moldings made of thermosetting materials, such as phenolics or ureas, but it also applies to thermoplastic materials.

With thermoplastics, present injection molding presses generally do not produce economically parts weighing over 24 to 32 ounces; the wall thickness, preferably, should not exceed 1/8 inch. A minimum thickness of 1/32 inch is satisfactory if the area of the part is not too large. Parts too large for production in one piece can often be made, of course, in two or more smaller sections, which can be fastened together by any of several means.

What has been said is based upon present standard molding practice. Other methods of molding, some of which are now in the experimental stage, give promise of becoming practicable, but are not yet in extensive commercial use. All recommendations made here apply to the use of well established methods, materials, and equipment, unless otherwise indicated.

Various Types of Molding Processes

As the method of molding employed has some effect on the design of parts to be molded, as well as upon the type of plastic chosen, the designer should know, at least in a general way, what primary types of molding (and of molds) are employed, and what the molding process involves.

In nearly all molding (except injection molding), the mold is first heated, either electrically or by steam, to the required molding temperature. Molds generally comprise two parts. The die proper contains the cavity, shaped to give the required contour and external shape to the piece to be molded. The mating portion of the mold includes what is variously termed the "plunger," "ram," or "force," which is shaped to form that part of the piece with which it makes contact. That portion of the mold containing the cavity is fastened usually to the lower press platen, which is often movable, and the force is fastened, as a rule, to the upper platen or head of the press. When ready for molding, a measured amount of material, usually in powdered or granular form, is placed in the mold cavity, whereupon the operator closes the mold. The plastic is thus subjected to heavy pressure, as well as to the required temperature, and, while in truly plastic form, is forced to assume the shape of the mold cavity.

If the plastic be of the thermosetting (permanently hardening) type, the heat causes it to "cure" and to harden. If a thermoplastic be used, the mold must be cooled (unless already cool) to harden the plastic. When the plastic is hard, the mold is opened and the molding is ejected.

There are several types of molding, and, in some, different kinds of molds are used. First there is compression molding, performed, as a rule, with heated molds, usually in vertical presses. It consists of applying heat and pressure to the plastic, which is first loaded into the mold cavities, usually by hand. This method is the one most extensively employed at present. It permits of using either the thermosetting types

of plastics (some of which are among the lowest in cost per pound) or the usually more expensive thermoplastics.

Types of Molds Used in Compression Molding

In compression molding, three distinct types of molds are used: Fig. 1 shows what is known as a "positive" type, in which the force, which is a close fit in the cavity, compresses the material as a ram or piston might do. The maximum or closing position of the force is limited by landing strips placed on top of the cavity block or chase. This type of mold produces a very dense molding, provided the material is accurately weighed or measured and a tight fit is maintained between the force and the cavity. Certain materials require this type of mold to insure satisfactory results. The flash or overflow, if any, is always vertical.

Fig. 2 shows a flash type of mold, the flash formed being horizontal. There is no well above the cavity. It is often essential with this type of mold to use preforms, shaped almost to the size and shape of the finished product. Furthermore, great care must be exercised in closing the mold, as it is necessary that the material be partially softened or fluxed before the final closing. Flash type molds sometimes cost less than positive types, but are not used extensively because of the foregoing objections, and because, since there must be enough plastic to more than fill the cavity after the plastic is compressed, there is a thick flash, with considerable waste of material.

Fig. 3 illustrates what is generally known as a "semi-positive" mold. It is, in reality, a combination of the flash and the positive types. The molding material is compressed into the cavity, much as in a positive type. The overflow or flash is first extruded upward, but is trapped and cut off at the edge of the horizontal "land." The flash at this land is generally from 0.003 to 0.010 inch thick.

Fig. 4 shows an alternative design of a semi-positive type of mold. In this design, the force does not telescope into the cavity, as in that shown in Fig. 3, but rather into the well above the cavity proper. The land or cut-off is horizontal, and the flash forming is of the same thickness as in Fig. 3. Semi-positive molds are usually required in the molding of urea-formaldehyde plastics; the type illustrated in Fig. 3 is preferable to the one shown in Fig. 4.

Injection Molding

Comparatively young, but having enjoyed a phenomenal growth, is the process that is known as injection molding. With this process, thermoplastic material in granular form is fed from a hopper by gravity into a heated cylinder, from which it is forced by a plunger into the mold after the material has been made plastic by the heat. High pressure is required to force the plastic through heating passages, orifice, nozzle, and gates into the closed mold or cavities, where the material sets. The mold is kept constantly cool, generally by having water circulating through channels around the cavities.

The injection molding process is accomplished at a very rapid rate, with 75 to 300 "shots" or mold fillings per hour. The mold is opened and the parts are ejected almost immediately after it is filled. Unless inserts are required for molding the part, the operation is practically automatic.

Another type of injection molding is being done on a limited scale with certain kinds of thermosetting materials. This involves heating the plastic in a cylinder, which is separate from the mold cavity proper but is connected with it by a gate or gates. As soon as fluxing occurs, pressure of the ram forces the material through the gate into the heated cavity where the plastic remains until cured. Slightly more than enough plastic to fill the cavity and the necessary gate is placed into the cylinder for each filling. A thin flash remains in the cylinder, and as the flash and gates harden permanently, they constitute waste. This process is sometimes referred to as "transfer molding."

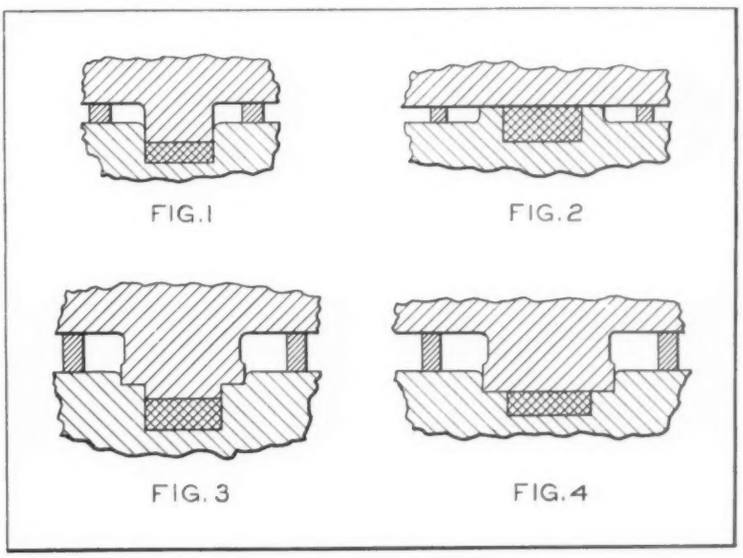


Fig. 1. So-called "Positive" Mold, in which the Force or Plunger Fits the Die Cavity. Fig. 2. Flash Type of Mold. Fig. 3. Semi-positive Type of Mold. Fig. 4. Another Design of Semi-positive Mold

Cold Molding

Cold molding is really a form of compression molding, but differs somewhat from the conventional form of compression molding. Some special equipment for mixing the material in batches shortly before it is to be used is required. The material is then fed in measured amounts into an unheated mold and is quickly rammed into the cavity, using, in general, a toggle or other quick-acting press. In consequence, the process is sometimes referred to as "impact" molding. The moldings are then immediately ejected, and after being loaded on trays, are placed in an oven to be baked for several hours.

The filler used in making these plastics is largely asbestos. Among the binders used in the material are bitumen or pitch, cement, resins, and oxidizing oils. The first two are the least expensive and the most plastic. Cement plastics are refractory and quite brittle when cured. The resin types are stronger than those with pitch or bitumen binders, but are somewhat less heat-resistant. Cold molding is done, as a rule, quite rapidly, and usually with molds having one or two cavities, but the subsequent baking of the moldings requires special equipment and considerable time. There are variations of the process, in some of which the mold is heated, although moldings do not remain in it long enough to "cure." Rubber is among the binders sometimes used, especially in molding storage battery cases.

When Molded Plastics Should be Used

In general, plastics in molded form should be used whenever engineering considerations indicate that the properties they possess will meet the requirements, provided, of course, that the number of parts needed is sufficient to justify the mold cost and that the cost per piece is as low or lower than the cost involved in other methods of production with materials that are satisfactory for the purpose. It is seldom economical to employ plastic moldings when the quantities required are less than from 1000 to 5000 pieces; but when the quantities exceed these figures, and the part required is well adapted for molding, marked economies often result from using this process.

Molded plastics are especially adapted for use where one or more of the following conditions must be met:

1. When a dielectric is required and the shape is not such that a punching from a sheet material or a part made from rod or tube would be cheaper.
2. When the shape of the part and other conditions are such that molding is an economical means of production.
3. When the elimination of an applied finish is essential or adds to economy.
4. When the colors or decorative effects available are advantageous.
5. When transparency, translucency, or unusual opaque effects are desired.
6. When minimum weight is required.
7. When a high degree of corrosion resistance is important.
8. When the low heat-conduction rate is advantageous, as in handles and heat-insulating parts.
9. When such properties as wear resistance, unusually smooth surfaces, freedom from odor and taste, resistance to moisture, moldability around inserts, or a considerable degree of resilience are desirable.

Not all plastics yield all these properties or advantages in like degree, but the foregoing list includes all the major and several less important advantages which can be gained by the intelligent application of molded plastics. In some cases, molded plastics can be substituted with advantage for metals and they can often be used in place of non-metallic materials; but, in general, plastics are more brittle and usually lack the strength of metals. Their cost per pound is nearly always higher than that of those metals that are in most common use, but their low specific gravity sometimes offsets this advantage. Production rates are usually lower than for the more rapid of the metal-working processes, but this, too, is often offset by savings in finishing costs and by other economies.

The next installment in this series of articles will briefly describe the types and characteristics of molding plastics, and will give general rules for the design of plastic parts.

* * *

Charts for Selecting Flexible Couplings

Time-saving charts for selecting flexible couplings have been prepared by the Lovejoy Flexible Coupling Co., known as the "L-R Selector Charts." With these charts, anyone can easily and quickly find the right flexible-shaft coupling to use, whether it be for light or heavy duty, when the horsepower and revolutions per minute at which the coupling will operate are known. As an example, suppose it was desired to connect a driving power unit of 140 H.P. at 700 R.P.M. with a driven unit having greatly fluctuating loads and requiring high protective resilience. The charts would show almost instantly the size and type of coupling required for this kind of load. Copies of the charts are available, without charge, from the Lovejoy Flexible Coupling Co., 5001 W. Lake St., Chicago, Ill.

MACHINERY'S DATA SHEETS 461 and 462

TYPICAL APPLICATIONS OF SAE STEELS—11

This listing, based on the 1941 SAE classification of steels, is not intended to be complete, but rather to indicate by typical examples what steels are suitable for various types of applications.

Sectors

Low-carbon steels Nos. 1010 and 1015.

Low-carbon steel No. X1015 has improved machinability and hardening properties, due to its manganese content.

Shift Forks and Rails

Low-carbon steel No. 1030 is used for forged, machined, or cold-worked parts requiring higher physical properties than are obtainable with the lower carbon steels. It machines satisfactorily either without annealing or after a simple normalizing. Suitable for casehardening where core hardness is desired or for parts of large section, but does not come within the carburizing steel classification.

Shovels

High-carbon steel No. 1080, used principally by the agricultural industry.

Springs

Medium-carbon steel No. 1040 is used for spring clips.

Medium-carbon steel No. 1055 is suitable for hard drawn, oil-tempered, or patented spring wire, and for general spring applications.

Medium-carbon steel No. 1060 is used for valve springs, cushion springs, clutch springs, and spring clips. For heat-treated springs, a hardness of 45 to 50 Rockwell C is recommended.

Medium-carbon steel No. 1065 is suitable for automobile valve springs, hard drawn spring wire, and coil springs for general purposes. For heat-treated springs, a hardness of 43 to 48 Rockwell C is recommended.

Medium-carbon steel No. X1065 is suitable for coil springs of hard drawn or oil-tempered wire and heat-treated springs of larger section than those for which steel No. 1065 is intended. For heat-treated springs, a hardness of 40 to 48 Rockwell C is usually recommended.

High-carbon steel No. 1080 is used for springs mainly in the agricultural industry.

High-carbon steel No. 1085 is used for leaf springs.

High-carbon steel No. 1090 is used for leaf springs and coil springs.

High-carbon steel No. 1095 is used for leaf springs and coil springs.

Chromium alloy steel No. 5150, an oil-hardening type, is suitable for springs.

Chromium-vanadium steel No. 6150 is suitable for heat-treated leaf and coil springs where high strength and anti-fatigue properties are essential.

Silicon manganese steels Nos. 9250 and 9260 have been standardized particularly for leaf spring usage.

Steering Knuckles

Nickel-chromium steel No. X3140.

Molybdenum steel No. X4130 is also used to some extent.

Steering Knuckle Arms

Molybdenum steel No. X4130.

Steering Knuckle Pins

Molybdenum steels No. 4815 and No. 4820.

MACHINERY'S Data Sheet No. 461, March, 1942

TYPICAL APPLICATIONS OF SAE STEELS—12

This listing, based on the 1941 SAE classification of steels, is not intended to be complete, but rather to indicate by typical examples what steels are suitable for various types of applications.

Studs

Low-carbon steel No. X1025, a higher manganese variant of steel No. 1025, has improved machinability and physical properties.

Medium-carbon steel No. 1040 has fair machining properties, deep-hardening characteristics, and is suitable for small and medium-sized plain carbon-steel forgings.

Free-cutting steel No. 1112, a Bessemer screw stock, has excellent machining characteristics but also has the unfavorable property of cold-shortness, and thus is not suitable for vital parts.

Free-cutting steel No. X1112, a higher sulphur variant of steel No. 1112, has improved finish and machinability, but is only used where production speed and excellent finish are essential.

Free-cutting steel No. 1115, commonly known as open-hearth screw stock, is somewhat inferior to steels Nos. 1112 and X1112 in machining properties, but has a better combination of strength and toughness.

Nickel steel No. 2330 is primarily used for automotive, aviation, and agricultural parts where high strength and toughness are needed.

Nickel-chromium steel No. 3130 is used for water-quenched parts where greater strength and toughness are required than can be obtained with plain carbon steels. One use is for cylinder studs.

Nickel-chromium steels Nos. 3135 and 3140 are used for heat-treated structural parts where good physical properties are required.

Molybdenum steels Nos. 4815 and 4820 are used for studs of high strength.

Chromium-vanadium steel No. 6135, a medium-carbon grade, is also used for studs.

Transmission Gears

See Gears.

Transmission Shafts

See Shafts.

Tubing

Low-carbon steel No. 1020 is employed for welded tubing.

Low-carbon steel No. 1030, which responds well to heat-treatment and machines satisfactorily, is used for seamless tubing.

Medium-carbon steel No. 1040, which has fair machining properties and deep-hardening characteristics, is used for tubing and tubular front axles.

Molybdenum steel No. 4140 is used for front-axle tubing.

Washers, Lock and Thrust

Medium-carbon steel No. 1060 is used for lock-washers and thrust washers.

Chromium alloy steel No. 5150 is used for thrust washers.

Wrist-Pins

Low-carbon steel No. 1020, a standard carburizing grade of carbon steel.

Low-carbon steel No. X1020, a higher manganese variant of No. 1020, has improved machining and hardening properties. It carburizes and hardens freer from soft spots.

MACHINERY'S Data Sheet No. 462, March, 1942

Factors Affecting Maintenance of Oil-Filled Hydraulic Systems

By P. N. OBERHOLTZER, Pump Engineer
American Engineering Co., Philadelphia, Pa.

THE tremendously increased production schedule required to meet war needs makes it necessary to give more and more attention to methods of plant housekeeping in order to keep equipment in service with a minimum amount of idle time.

In normal times, many plants paid little or no attention to cleanliness of equipment, and ran their machinery with a minimum of maintenance until it failed. Some plants, of course, did provide spare equipment to take care of emergencies. Now, however, with schedules calling for twenty-four hours a day, seven days a week, spare equipment is not available, and no machine can be permitted to remain idle any longer than is absolutely necessary. The managements of many plants are beginning to realize the importance of a systematic maintenance schedule, and consequently are avoiding a lot of grief that results from the haphazard care of equipment.

The factors affecting the maintenance of hydraulic systems are, generally speaking, the same as those involved in the operation of any equipment. Since we are confining our attention to oil-filled hydraulic systems, the first factor to be considered is the selection of the proper type of oil. Second in importance is cleanliness—keeping dirt out of and away from the machines as much as possible.

The proper type or grade of oil is more important than anything else. Much can be written concerning this subject, but only the high spots will be covered here, since it is not our purpose to deal solely with the selection of lubricants.

Oil-filled hydraulic systems require the use of precision made pumps with moving parts which, of necessity, are manufactured to small clearances. The oil selected must not only provide lubrication for these closely fitting surfaces, but in many cases, it must also stand up under operation at high pressures.

Most of the trouble experienced results from

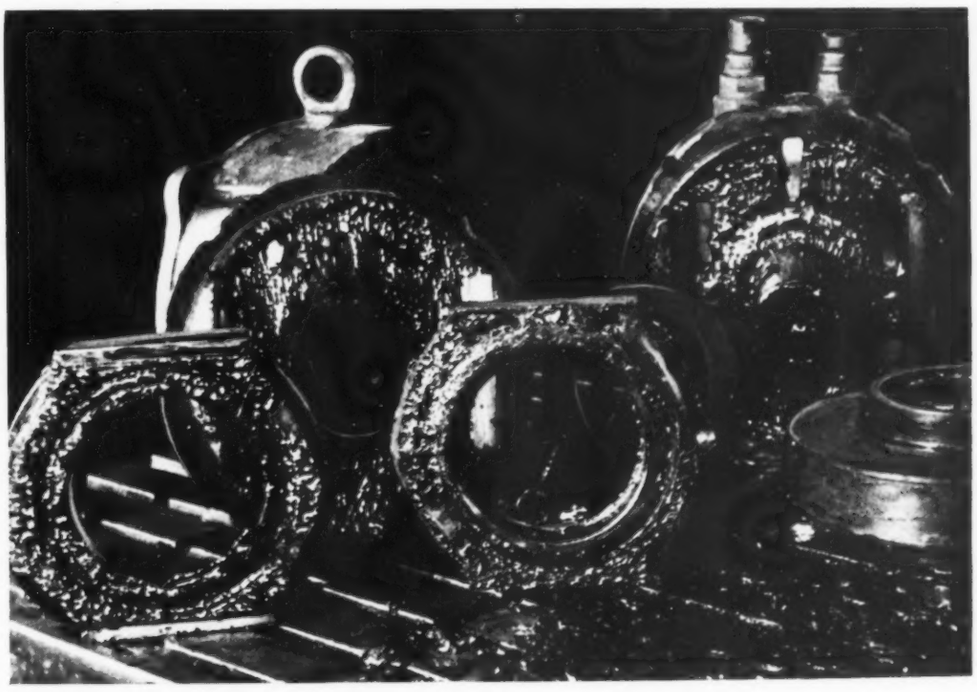


Fig. 1. Hele-Shaw Transmission Coated with Sludge Baked on at High Heat—a Good Example of what may Occur when an Inferior Oil is Used

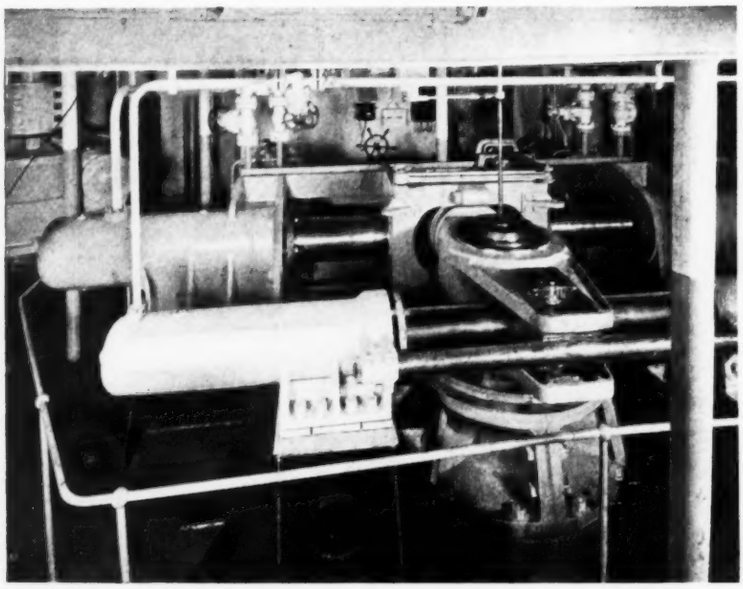


Fig. 2. American Engineering Co.'s Electro-hydraulic Steering Gear for Ships. Such Equipment Requires Oil of High Viscosity Index because of the Wide Range of Temperatures Encountered

the formation of sludge and the gumming up of various moving parts, especially in the valves. Fig. 1 shows very clearly the result of operation with an inferior grade of oil. All the internal parts of this Hele-Shaw transmission were heavily coated with sludge, in some places 1/4 inch thick. The formation of sludge created excessive friction, with consequent increase in temperature of the operating parts. Operation at high temperature caused the sludge to harden and practically bake on the parts of the machine.

Factors to Consider in Selecting an Oil for Hydraulic Systems

The manufacturers of oil hydraulic equipment in most cases give definite recommendations as to the proper oil to use. Be careful of substitutes that are claimed to be just as good.

The general requirements for a good hydraulic oil are: (1) Proper viscosity; (2) high viscosity index; (3) resistance to wear; (4) high demulsibility; (5) low neutralization number; and (6) stability.

Proper Viscosity—Oils commonly used in hydraulic circuits have viscosities ranging from 150 to 1000 Saybolt seconds universal at 100 degrees F. For any specific installation, there exists one viscosity that will give the best results. If the viscosity is less than that recommended, the leakage will be increased, reducing the efficiency of the equipment. Oils having a higher viscosity than recommended produce a greater resistance to flow, with a consequent decrease in efficiency. Generally speaking, gear, vane, and axial piston pumps may be operated with viscosities ranging from 150 to 300 Saybolt seconds universal at normal temperatures. Radial piston pumps usually require higher viscosities, namely, 600 to 1000 Saybolt seconds universal at 100 degrees F., or even higher under certain conditions.

In selecting the proper viscosity, consideration, therefore, must be given to the range in temperatures likely to be encountered and the maximum operating pressure.

High Viscosity Index—An oil having a high viscosity index is one that has a minimum change in viscosity throughout a given temperature differential. Naphthenic and asphaltic base oils have, in general, a lower index than paraffinic oils. To illustrate the effect of viscosity index, let us take a certain oil having a viscosity of 1000 Saybolt seconds universal at 100 degrees F. and a viscosity index of 50. This oil would have a viscosity at 60 degrees F. of 6000 Saybolt seconds universal, and a viscosity at 210 degrees F. of 75 Saybolt seconds universal. Take another oil of the same viscosity—1000 Saybolt seconds universal at 100 degrees F.—and a viscosity index of 100. The viscosity of this oil at 60 degrees F. would be about 4000 Saybolt seconds universal, and at 210 degrees F., it would be 90 Saybolt seconds universal.

With the oil having the low viscosity index, difficulty in starting up the unit might be encountered if the oil temperature was at 70 degrees F. or less. At any rate, the operation of the equipment would be more sluggish when first started than with the oil having the high viscosity index. A good hydraulic oil should have a viscosity index of 75 or over.

Fig. 2 shows the hydraulic rams of an electro-hydraulic steering gear such as is used on many vessels, both for the merchant marine and the Navy, for actuating the rudder. The large cylinder in the middle background is operated by a reversible discharge Hele-Shaw pump. The small ram in the foreground is used for hand steering. Between the two is the rudder stock. Since ships must travel all over the world, they are subjected, of course, to a wide range in temperatures. The pumping units should accordingly be supplied with an oil that has a high viscosity index. If low viscosity index oils are used, trouble may be encountered when operating in regions having extreme temperatures.

Resistance to Wear—Resistance to wear means high film strength, and this feature becomes of special importance in hydraulic sys-

tems operating at high pressures, say 1000 pounds per square inch and over. Many automotive oils are advertised as having increased film strength. The standard oil for use in gear transmissions for a number of years was 600W, and this oil contained an animal fat, which increases the film strength. In fact, in certain compounded cylinder oils lard or tallow is added to increase the film strength.

This will recall the story of the old-time test engineer who always carried a pocketful of tallow candles. If he found that his equipment was becoming overheated or not acting quite "up to snuff," he would drop a few candles in the oil reservoir and get through the tests satisfactorily. There are other additives, of course, such as certain aromatic halogens, chlorine or sulphur compounds, which tend to improve the film strength of oils.

There is every indication that we may expect to see increased use of oils containing such additives. Excellent results have been reported with such oils, and improvements may be expected that will make treated oils universally acceptable.

High Demulsibility—Demulsibility of an oil means its ability to separate quickly from water or moisture. Those of you who are familiar with oil specifications recall that a satisfactory oil must have a demulsibility rating of 1620 or over. This is the Herschel demulsibility number.

Oils with low demulsibility rating do not have the property of rapid separation from water, and consequently, an emulsion is formed when moisture is present, resulting in lower film strength. Oils with low demulsibility also retain air more readily than oils with a high rating.

Air in a hydraulic system is responsible for many operating difficulties that are frequently attributed to other causes. Air in the system will produce erratic operation, accompanied by considerable noise. It can be eliminated temporarily by opening the bleed valves that should be a part of every hydraulic system. Continued trouble from this source calls for a thorough examination of the piping and valves. All joints should be tightened, and every possible source of air entrance carefully checked.

Low Neutralization Number—The neutralization number of an oil defines the relative amount of acid present. Oils having high acidity tend to sludge easily and produce corrosion and pitting of the highly finished parts. Oils for hydraulic systems should have a neutralization number of 0.10 or less when new.

Stability—Stability is that property of oils which means resistance to oxidation and deterioration. Oxidation may cause an increase in the viscosity or it may show up by darkening the color, or by the formation of sludge or gum.

As an illustration of the effect of stability, the writer recalls one installation where the customer complained that he had to add five gallons of oil every week to his system, although he could not detect any leaks in the pipe or valves. Analysis of the oil showed that it was oxidizing very rapidly, and practically all the loss was due to evaporation, with some sludge formation. When the proper grade of oil was used, it was no longer necessary to add oil every week.

Generally speaking, therefore, a satisfactory oil for use in hydraulic systems would be one known as a turbine oil or oil of turbine quality.

The Maintenance of Cleanliness is Important

Next in importance to the proper type of oil is cleanliness. This involves periodic cleaning of the equipment, preventing the introduction of dirt into the oil, and periodic changing or cleaning of the oil in the system.

It is a surprising fact that few operators pay attention to keeping the machine, especially the pumping unit, clean. Almost all hydraulic systems leak, if only enough to coat the pipes and valves with oil. This oil film collects the dust and dirt in the atmosphere, and frequently it

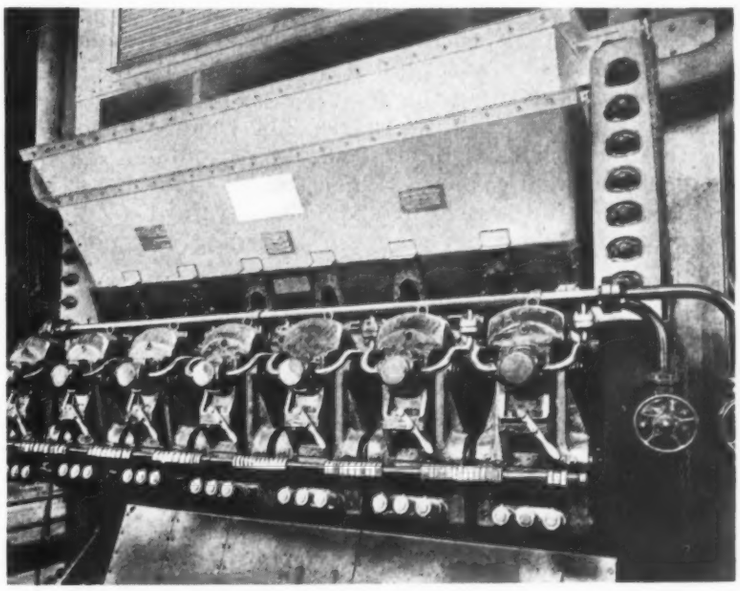


Fig. 3. Hydraulic Ram Type Taylor Underfeed Stoker Subjected to Dust-laden Atmosphere. Such Equipment must be Periodically Cleaned and the Oil Properly Filtered

gets into the oil reservoir. The proper use of filters will greatly aid in eliminating trouble from this source. But caution must be exercised in the use of filters, especially when placed in the suction line. Continued operation without cleaning the filter retards the flow of oil to the pump and may seriously damage it. The operator must be sure to clean the filter periodically or renew it, so that a flow of oil to the pumping unit is assured.

On installations not equipped with filters, care should be taken to prevent dirt from entering the bedplate. This can be done by installing a breather filter in the top of the reservoir, so that any dirt in the atmosphere will be excluded completely.

Fig. 3 shows a multiple retort, hydraulic ram type Taylor underfeed stoker. This stoker is operated by a reversible discharge Hele-Shaw pump. In this type of installation, the handling of the coal may produce a dust-laden atmosphere and coal dust will collect on all exposed parts. In some cases, coal dust finds its way into the pump and causes serious damage to the finely finished parts. The remedy, of course, is continual cleaning of the equipment, and if possible, elimination of the dust. If the pumping unit is kept clean and no dirt allowed to collect on it, there will be less danger of the dust getting into the unit. In this type of installation, it is especially important to supply a breather filter on the oil reservoir.

When a hydraulic system is first started in operation, all of the pipes, tubing, etc., as well as the oil reservoir, should be cleaned thoroughly. Even when this is done carefully, after several weeks of operation it will be found that considerable foreign matter has collected in the oil reservoir. Consequently, it is advisable to drain the reservoir and refill it with clean oil, after carefully cleaning the reservoir. Systems containing a filter will, of course, not require this treatment, but the filter should be periodically examined and cleaned. Whenever oil is introduced into the system, it should be strained through cheesecloth or fine-mesh screening to remove any dirt.

It is usually difficult to convince operators of the importance of clean oil, even after the evidence is presented to them. In fact, in most cases where trouble is encountered, the customer will claim that the equipment was defective and will expect the manufacturer to repair it or replace it free of charge.

A pumping unit should never be started without first making sure that a sufficient quantity of oil is in the system. The electrician, for example, may operate the pump before oil is introduced, just to check the motor rotation. If the pump is allowed to run long enough without oil, failure will occur.

It might be of interest to cite several cases of "trouble shooting" to illustrate just where trouble may occur. Of course, the customer almost always blames the manufacturer, and it is sometimes a difficult task to convince him that it is not the equipment, but the manner of operation that is at fault.

One case is recalled where the customer complained that the pump made a peculiar noise. Investigation disclosed that the noise was caused by the relief valve. Someone had changed the setting, and it was blowing at a very low pressure, producing the typical screeching noise that some valves make when they are operating.

In another case, the customer complained of improper operation after the pumping unit had been repaired. The unit had been in service for over ten years and was returned to the factory for overhauling. When the rebuilt pump was placed in service, the press operation was not satisfactory. Of course, nothing had been done by the customer that would cause any difference in the performance! However, after careful investigation, it was discovered that the packing in the press had been changed. The original packing had a very high coefficient of friction. The new packing was much more efficient and produced less friction on the ram. Consequently, there was not sufficient drag and the ram dropped, due to its own weight. A foot-valve had to be installed to remedy this condition.

Don't be in a hurry to blame the manufacturer. Be sure that you have followed his instructions and review them carefully. Try to determine for yourself what caused the trouble and what was done that might be contrary to the instructions.

Summarizing the factors affecting maintenance, the following points are suggested:

1. Use the proper oil.
2. Maintain the oil at the recommended temperature.
3. Keep the oil clean.
4. Keep the machine clean.
5. Periodically tighten all joints and foundation bolts.

If these few simple rules are followed, your hydraulic equipment should have a long life.

* * *

More than 19,000 employes were added to the forces of the Westinghouse Electric & Mfg. Co. in 1941. In January, 1942, employment was at an all-time high of about 78,000, compared with 50,500 at the beginning of 1941. The company employs more than 300 sub-contractors to produce equipment normally manufactured in the Westinghouse plants, and equipment ordered by the U. S. Government. Sub-contracts amounted to $18,500,000 in 1941.

Coolant Clarification for Grinding, Honing, or Superfinishing Machines

Importance of Providing Clean Coolant, Free from Grit, and Equipment Used for Clarification—Based Upon Data Furnished by the De Laval Separator Co.

REMOVAL of abrasive sediment from coolants by means of a coolant clarification system is of great importance in effecting production savings and improving the finish of ground, honed, or superfinished parts. The clean coolant speeds up finishing operations by permitting grinding nearer to finished dimensions, with much less likelihood of distortion of the work.

These advantages of clarified coolant result from the fact that the free abrasive grains in sediment-contaminated coolant are relatively large, compared with the usual depth of cuts, so that deep scratches are produced when these stray abrasive grains and steel particles come between the grinding wheels or hones and the work. As a consequence, more metal must be removed during finish-grinding or honing in attempting to erase these marks.

In addition to eliminating these troubles resulting from the use of contaminated coolant, a "Hermetic" clarifier prevents the entraining of air in the coolant during the cleaning process, thus assuring uniform flow and minimizing the possibility of local heating and check marks on the work.

In some cases, where a fine finish is required, city water has been substituted for grinding coolant, the water being discarded after a single pass over the work. While this prevents dirt from coming between the wheel and the work, the advantages of a properly prepared grinding coolant are sacrificed, and the expense involved in discarding the cooling medium after a single pass over the work is high. Moreover, the use of city water greatly increases the likelihood of rusting, both of the machine and of the work. The use of a properly prepared coolant, continuously clarified, is, from every standpoint, the more economical and more efficient method of cooling and lubricating the work and wheel during grinding and honing operations.

Precision grinding may, at times, call for a comparatively expensive type of coolant, in which case, conservation of the coolant becomes a real problem. Here, again, a clarifier performs an important service in guarding against loss of coolant due to contamination.

The use of dirty coolant has as serious an effect on the grinding wheel as on the work. Metallic sediment in the coolant is pressed into the face of the wheel, greatly reducing its cutting action and making necessary more frequent dressing of the wheel. In the case of soft wheels, which usually require dressing operations only to maintain the wheel form, the presence of abrasive and metallic sediment in the coolant causes the wheel to wear away much more rapidly than is necessary for good cutting action.

Clarifiers Permit Coolant to be Used Indefinitely

Unless the coolant is systematically clarified, it rapidly becomes contaminated with organic material, in addition to the abrasive and metallic particles. In a short time, the coolant becomes so dirty that it must be discarded and the tanks must be cleaned, with resultant loss in coolant and production; in addition, there is the cost of labor for cleaning. The coolant clarifier removes organic materials—such as rubber, shellac, glue, and other resinous products—and so enables the coolant to resist rancidity for an indefinite period. Thus, the liquid is maintained in a more sanitary condition. This fact, together with the removal from the coolant of sharp cutting particles, greatly reduces the hazard of infection among workmen.

One type of equipment equally applicable to oil and aqueous coolants is the "Hermetic" coolant clarifier manufactured by the De Laval Separator Co., Poughkeepsie, N. Y. Although most grinding in the past has been done with aqueous coolants, there is an increasing use of various specially compounded mineral oils for high-grade precision grinding and honing. Centrifugal clarification of such coolants is of particular importance because the standards of finish that necessitate the use of such oils are much higher and the cost of the coolant is many times greater. Moreover, the settling rate of particles in oil coolants is slower than in the lower viscosity aqueous coolants, so that the use of a settling tank alone is even more ineffective when oil is used.

Installation of equipment capable of maintaining grinding and honing coolants in proper condition and effecting the economies and improvements in quality involves no radical change in shop lay-out. The necessary equipment includes one or more clarifiers, a centrifugal pump to feed the clarifier, and a storage tank.

Most grinders contain their own sump tanks, with a pump which continuously delivers coolant between the work and the wheel. Many companies operating batteries of grinders have found the maintenance of these individual grinder pumps and the cleaning of the many small tanks quite expensive, and have already installed centralized coolant systems. Such systems usually employ a common tank for settling out a portion of the dirt that accumulates in the coolant, and a pump for returning the coolant from the tank to all of the grinders. The addition of a clarifier greatly improves the efficiency of such a system.

In applying the De Laval system to a battery of grinders, coolant is pumped from the tank through the clarifier directly to the grinders. Hence, in shops already having centralized coolant systems, it is only necessary to install the clarifier in the return line to the grinders with a suitable pump, which may already be in use, in order to obtain the advantages of centrifugally clarified coolant. Overhead storage tanks are not required in order to maintain a constant flow of coolant to the grinders, since the coolant is discharged under pressure from the clarifier.

It is obvious that, with such a system, the heavier and more easily removed impurities settle out in the tank, and the finer impurities and organic materials are removed by the clarifier. The additional impurities removed by centrifuging are those that have previously reduced the efficiency of the grinding operation.

Clarifiers are available in the large capacities required for serving batteries of grinders, and for best results, the capacity of the clarifier or clarifiers installed should equal the combined circulating rate of all grinders connected to the system. This means that only clean, centrifugally clarified coolant is returned to the grinders.

While the sediment removed by the clarifier is retained in the bowl, which must be cleaned from time to time, a storage tank of ample capacity will enable much of the coarser material to be removed before the coolant is fed to the clarifier. Hence, the clarifier will often run from a few days to a week before removal of sediment is necessary. In any event, the time required to take care of the clarifier installation will, in all cases, be much less than the single item of cleaning sumps in a plant where grinders are not equipped with an efficient clarification system.

Machine Tool Builders Receive Navy "E" Pennant

The Warner & Swasey Co., Cleveland, Ohio, builder of turret lathes, has been awarded the U. S. Bureau of Ordnance flag and the Navy "E" pennant in recognition of "outstanding efforts in the production of ordnance materiel vital to our national defense." The presentation of the award was made by Rear Admiral Henry V. Butler, Jr. at the change from the first to the second shifts in the new wing of the Warner & Swasey plant, in the presence of the company's employes. Each of the 3600 employes of the company received a bronze emblem bearing the insignia of the Bureau of Ordnance and the Navy "E." At the presentation, Colonel Frank A. Scott, former president of the Warner & Swasey Co. and chairman of the War Industries Board during the first World War, acted as master of ceremonies.

The South Bend Lathe Works, South Bend, Ind., was also recently awarded the Navy "E" pennant for outstanding performance. The company has consistently been ahead of schedule on lathe shipments for the Navy and its prime and sub contractors. Formal presentation of the award was made at the South Bend plant during the noon hour on February 3, so as to enable the employes to be present without losing any time on production. Representing the Navy were Rear Admiral Henry V. Butler, Jr., Captain Henry P. Burnett, Lieutenant L. F. Brozo, and Ensign John T. Barnett. The company was represented by John J. O'Brien, chairman of the board of directors, and R. E. Frushour, president of the corporation.

* * *

Code for Health Protection in Foundries

Recently, the Government requested the foundry industry to draft a set of rules and recommendations to be used as a guide in providing safeguards for foundries, so that the maximum operating capacity will not be endangered at this critical time. Accordingly, the American Foundrymen's Association has formed a committee to draft a code of rules relating to numerous foundry operations, including recommended practices for grinding, polishing, and buffing equipment; a handbook on fundamentals of design, construction, operation, and maintenance of exhaust systems; recommended practices for metal-cleaning sanitation; and safety practices for the protection of workers in foundries. James R. Allan, of the International Harvester Co., is chairman of the committee, which is known as the Industrial Hygiene Codes Committee of the American Foundrymen's Association.

Shaper Fixture for Machining Special Cams

By L. KASPER, Philadelphia, Pa.

Cam-plates, such as shown at *W* in the illustration, with the working outline composed of two internally tangent arcs of radii *X* and *Y*, and the working surface formed on the arc of a circle, as indicated at *R*, present a machining problem that cannot be handled by conventional methods. The problem was solved, however, by the use of a special fixture designed as shown in Figs. 1, 2, and 3. As the arc *R* of the working surface made it impossible to use an end-mill, it was decided to shape the surface with a form tool *J* on a small shaper.

The angle casting *A* of the fixture carries the lever *B*, which is free to turn on stud *C*. Stud *C* is so located that the distance from its center to the cutting edge of the tool *J* is equal to the radius *X*. Lever *D* is free to turn on stud *E*, which is carried on the upper end of lever *B*. The distance from the center of stud *E* to the cutting edge of tool *J* is equal to the radius *Y*. The spring *M* holds the levers *B* and *D* in alignment, so that lever *D* can be rotated on stud *E* only by overcoming the tension of spring *M*.

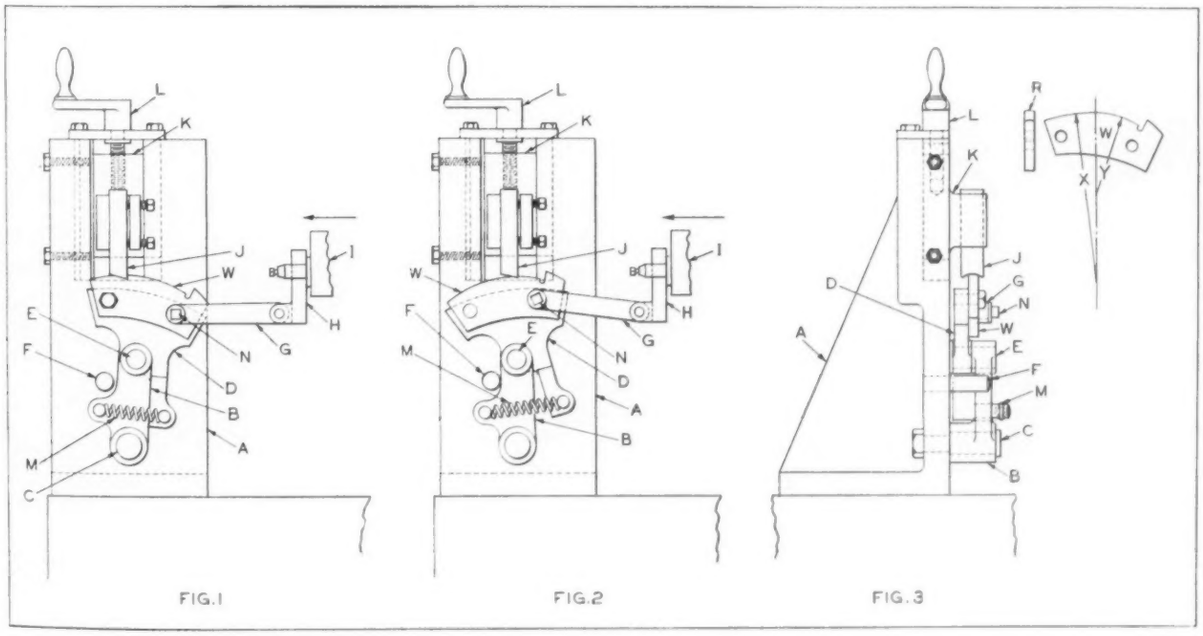


Fig. 1. Fixture Used on Shaper for Machining Cam Surface of Work W. Fig. 2. Fixture Shown in Fig. 1 with Cutter J Forming Cam Surface to Radii Y and R. Fig. 3. End View of Fixture with End and Side Views of Work W

The cam-plate *W* is attached to the upper end of lever *D* by the screw and the stud *N*. The bracket *H* is carried in the toolpost of the shaper head *I*. The link *G* connects bracket *H* with stud *N*, so that the motion of the shaper head is transmitted to the lever *D*. The slide *K* is dovetailed to fit the dovetail groove in the upper end of angle member *A*. Vertical adjustment of slide *K* is provided by a screw through the handle *L*. Slide *K* carries the forming tool *J*. A pin *F* in angle member *A* limits the movement of lever *B*.

On the forward stroke, the shaper head *I*, moving in the direction indicated by the arrow, swings the work about the stud *C* through link *G* and levers *B* and *D*. During this partial revolution of the work on stud *C*, the stationary cutter *J* takes a forming cut on the radius *X*. As the shaper head *I* moves still further forward, the lever *B* comes in contact with pin *F* which arrests its movement. When the movement of lever *B* ceases, further movement of the shaper head *I* causes lever *D* to rotate on stud *E;* this changes the radius of the forming cut from *X* to *Y*. The end view of the fixture, Fig. 3, with the shaper head *I* omitted, shows construction details not revealed by Figs. 1 and 2.

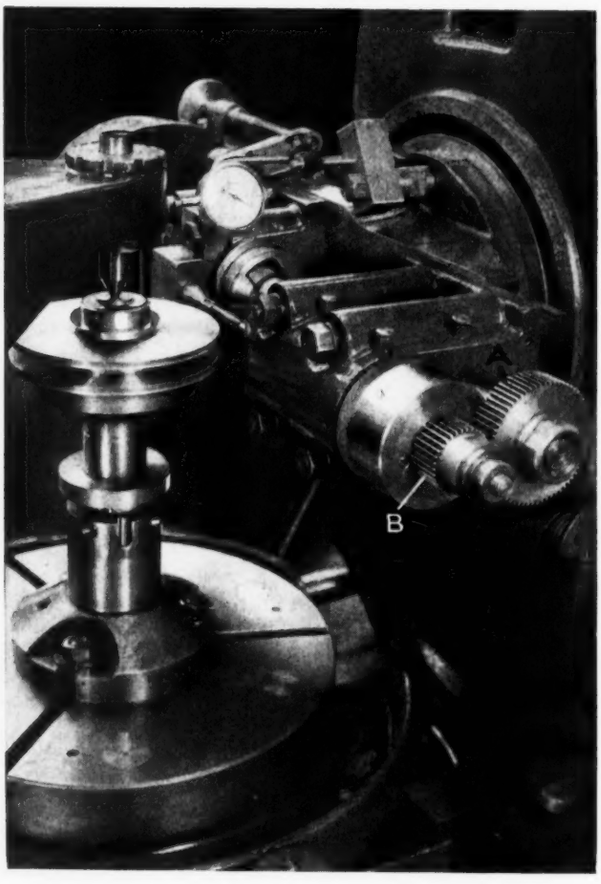


Fig. 1. Gould & Eberhardt 18-H Gear-hobbing Machine Equipped with High-speed Attachment

High-Speed Gear-Hobbing Attachment

By O. S. MARSHALL, Pasadena, Calif.

The high-speed gear-hobbing attachment shown in the working position on an 18-H Gould & Eberhardt machine in Fig. 1 is designed chiefly for cutting small-pitch gears, ranging from 20 to 48 diametral pitch. It will also cut the teeth in gears having a high number of teeth without excessively high index-gear ratios, as will be explained.

Referring to Fig. 1, the gears for driving the fixture have a 2 to 1 ratio, 66 teeth for driver *A* and 33 teeth for driven gear *B*. These 20-pitch gears give the fixture a 120 to 1 ratio as compared with the 60 to 1 ratio of the hobbing machine. This arrangement provides the extra speed without increasing the normal speed of the machine. The increase in speed is confined to the cutter-spindle of the attachment and to the index- or work-table.

Fig. 2 shows all the parts of the attachment except the guard for the spindle drive gears, this having been removed to show the gear drive. The attachment is applied to the swivel head in place of the footstock, and is held in place by four bolts which engage two steel T-nuts, each nut consisting of a single bar, one for the upper slot and one for the lower slot. The bolts are of 1/2-inch stock, and the housing of cast iron. Bronze bushings are provided for the drive-bar and for the cutter-spindle sleeve. The drive-bar is a straight cylindrical member, and the cutter-spindle is tapered on its outer surface and threaded at the left end, which is smaller in diameter.

In case of wear, the cutter-spindle can be adjusted to maintain a close running fit. The cutter-spindle bushing is split its entire length for this purpose, a wooden key being inserted to insure its expansion against the retaining walls. The steel cutter-spindle sleeve is 1 1/2 inches in diameter, and has a thrust bearing collar 3 inches in diameter, and 1/2 inch thick. An ample supply of lubricating oil is provided by grooves on each side of the sleeve and by three holes in its periphery which lead to the grooves at the sides. This thrust member runs between two fiber collars, each 1/4 inch thick and of the same diameter as the thrust collar.

One of the fiber collars is shown in Fig. 2 attached to the adjusting thrust sleeve, the other being attached to the inner end of the housing. Both fiber collars are prevented from rotating by small screws. It will be noted that the housing is threaded to receive the thrust sleeve which is also threaded a sufficient length for strength and to meet adjustment needs. This sleeve is locked in position by means of a two-part "blind" wedge-pin of the familiar type, set

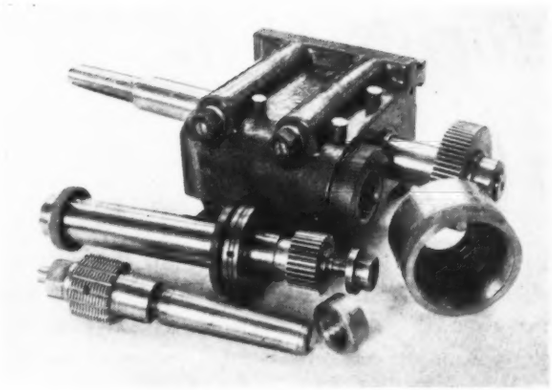


Fig. 2. Partially Disassembled High-speed Gear-hobbing Attachment

at 90 degrees, with the 45-degree face of one part forced against the 45-degree face of the other by means of a socket screw, the latter part being thus forced outward against the interior or threaded surface of the sleeve.

The housing is 7 inches long, and the center distance between the drive-spindle and the cutter-spindle is 2 1/2 inches. The cutter-spindle sleeve is 7 1/2 inches long up to its thrust collar portion which is 1/2 inch long. A shoulder 7/8 inch long extends through the outer fiber washer and the thrust sleeve. The driven gear occupies a length of 7/8 inch, and the retaining nut takes up the remaining 7/8 inch. The cutter sleeve is bored to receive a No. 9 B & S taper cutter-spindle. A 9/16-inch hole for the draw-rod continues through the cutter sleeve beyond the spindle section.

The cutter-spindle is threaded and provided with an adjusting nut at the end which carries the hob. This arrangement provides means for adjusting the position of the hob in relation to the tooth center without moving the main driving head. The housing is provided with three oil-holes at both sides to permit proper lubrication in case the swivel head is to be operated in both right- and left-hand positions, as when cutting right- and left-hand helical gears. There are also three equally spaced oil-holes around the thrust-sleeve collar to facilitate oiling in any position. A collar at the left end of the cutter sleeve, which screws on the end of the bronze bearing sleeve, prevents the entrance of dirt.

* * *

The Taylor-Wharton Iron & Steel Co., High Bridge, N. J., is celebrating this year its two-hundredth anniversary. The company, which has plants in Easton, Pa., and High Bridge, N. J., has been in operation continuously since 1742, when the original forge was built on the site of the present plant at High Bridge.

Skilled Men Needed in War Work Should Not be Drafted for Army

We must re-educate our local draft boards, and the public behind them, to the vital importance of the production front, even as compared with the combat front, said Harvey N. Davis, president of the Stevens Institute of Technology, in a recent address. Up to December 7 last, our draft boards did, on the whole, an extremely intelligent job of seeing to it that both the Army and the war industries got good men. Mostly they left skilled workmen in industry, where they belonged, and the public backed them in this wise use of their discretion.

I am told that one of the largest American manufacturers of airplane engines, which certainly are vital munitions of war, if anything is, lost to the draft during the four months before Pearl Harbor, on the average, only four or five skilled workmen per month. But in December, they lost to the draft about fifty skilled workmen, and in January about a hundred and fifty. That just doesn't make sense.

First of all, every draft board in the country ought to recognize the prior right of the war production industries to hold, not only every skilled workman, but especially every technically trained man on the production job, where he belongs, if we are to win this war. Every man in training for a war production job should be kept in training until he has fitted himself to play the most effective part he is capable of in this great war effort.

This applies alike to students in engineering schools, to students in both full-time and part-time defense training courses, and to technical men in war industries, no matter how recently inducted, provided only that they are trainable and in training. No draft board should say to a young engineer, "The Army needs you more than war industry does." The Army cannot possibly need any engineer in its drafted ranks more than it, the Army, needs that same engineer in some war industry.

If the young engineer is in the wrong industry, he should promptly shift, or be shifted, into the right industry; but in the light of the terrible shortage of technically trained men that faces us, it is sheer foolishness to invite, or even to permit, him to waste his training by shouldering a rifle.

* * *

According to information obtained from the American Gear Manufacturers Association, industrial gear sales for January, 1942, were over 11 per cent above January, 1941, and 18.5 per cent above December, 1941. This compilation covers only industrial gears.

American Factories Will Win or Lose the War

THE outcome of the struggle between the free nations of the world and the forces intent on destroying all the things for which mankind has fought and died for a thousand years, depends almost entirely on the output of our manufacturing plants. We have fighting men; but we must supply them with the weapons to fight with.

American industry and American labor are on trial. They are both faced with the greatest task of production that the world has ever known. In two years we must accomplish what our enemies have done in ten. Speed in production is the one thing necessary if we are to preserve our national way of life—for let there be no mistake, we are fighting for our national way of life.

The complacency that has made us believe that we could never be defeated by other nations must give way to a spirit of determination that we are not going to be defeated, no matter what the cost—and the cost will be high. We must all begin to realize that we cannot continue our ordinary ways of living while this struggle is going on. Like Great Britain, we must exert every ounce of effort, sacrifice the results of the work and enterprise of the past, in order that we may continue to live under institutions of our own free choice.

Many branches of industry have done a remarkable job. They have surpassed what was considered impossible two years ago—and yet this is not enough. The output even of the industries that have done their best must be increased if we are to win.

But there are also many establishments capable of producing war materials that have not yet converted their full capacity into these channels. It is not difficult to understand why the men responsible have hesitated to turn from the manufacture of the products of peace, through which they have added to the comforts and raised the standard of living of the American people in the past. They have built up their enterprises through initiative and hard work over many years. They are now asked to brush all that aside and to turn their plants over to the manufacture of entirely different things. But it must be done.

It is not only the great metal-working plants that must be converted to the output of war material; most of those plants already have been so converted. It is the plants that make all other kinds of products that must turn wholeheartedly to the war effort. The small factories and shops are also needed. Even the garages with a few machine tools can make some parts as sub-contractors that will be useful in this fight against the forces that are threatening to overwhelm us. This is being done in Great Britain, where every conceivable effort is made to defend the nation's existence. It must be done here also.

Labor leaders must take a different view of the national struggle than they have in the past. In too many cases, they have used the national emergency to bolster up their own power and the strength of their unions. In this effort they have, unfortunately, been backed up by our Government, which has failed to realize the seriousness of the situation. Plant construction has been held up; airplane manufacture — perhaps the most vital of all our efforts in winning the war —has been hampered and held back, sometimes by trivial disputes between different groups of labor.

The American people, when they realize the seriousness of the situation and find what sacrifices they must all make, will have little patience with the labor leader and the labor organizations that are still making use of the national danger to strengthen their own position. The labor leader who says that labor must not permit itself to lose any of the ground that it has won. no matter what the national emergency, does just as much to obstruct the war effort as a manufacturer who does not use his plant to the

best interests of war production because it means sacrificing his past achievements. Before this war is won, we will all learn what it means to sacrifice, and no one class or individual must expect to be exempt.

At last the war production effort, as guided from Washington, is largely in the hands of men with industrial and business experience and background. They understand what it means to get ready for production, and they know that the winning of the war is not a foregone conclusion unless American factories are geared to the utmost war effort. The important thing, these men say, is that American industry produce now. What we produce now — this month, this year — is worth many times what we will produce a year hence.

The important element is time. Our enemies are using this time to their advantage. They are profiting by our lack of preparation, by our lack of war materials. Every tank built this month may be worth ten built a year hence. Every airplane produced now may be worth a score a year from now. In every plant capable of doing anything whatsoever to further the war effort, the one question that should be asked is: "How much more can we do here to speed up, to produce?"

In Mr. Nelson as head of the War Production Board, we have a man who gives every evidence of being equal to the task. He has asked every factory in the United States to go to work on war production to the fullest extent possible; and it is amazing what industry can do when the men at the head use the same initiative and imagination on this task that they have used in building up their peaceful enterprises. We have today agricultural equipment plants making tanks, gas-stove manufacturers making aircraft sub-assemblies, a carpet mill making gun barrels, a motion picture machine plant building precision tools for aircraft manufacture, and a linoleum plant making shells, incendiary bombs, and aircraft parts.

A manufacturer making ladies' handbag frames is now making a charger for a rapid-fire gun. Not only did he have the initiative to convert his plant from one type of manufacture to the other, but he redesigned the charger in his own shop, submitted it to the War Department, and had it approved in order that available equipment might be used in producing the charger.

This is the kind of initiative that the nation expects from American manufacturers. They must go after the war work in the same way they have gone after their peacetime business in the past. Each shop must find out what it can do, and then go after an order for that kind of work.

There is a great deal of sub-contracting now being done; but at the same time, there are thousands of small shops throughout the country capable of acting as sub-contractors that have not yet been approached. The job is to find these shops. To a great extent, this should be done by the prime contractors. In every prime contractor's plant, there is usually one or more bottlenecks. To find the outside shop that can help break that bottleneck is a real contribution.

The important thing is for everyone to realize that unless we are all willing to exert ourselves—each in his place—to win the war, it may not be won at all. America and her allies are still on the defensive. Only the output of American factories can place us in a position to assume the offensive—and only if we can take the offensive can we win.

It is futile for either manufacturers or labor unions to consider what their conditions will be after the war. The main thing to ponder is that if we do not win the war, none of us will have much to say about what those conditions are to be. The answer as to whether we shall remain a free nation must come from American factories and American labor.

VICTORY

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Fill in on Form at Bottom of Page 159 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the March Number of MACHINERY

Better Grinding

LANDIS TOOL CO., Waynesboro, Pa. 96-page book entitled "Better Grinding," containing useful information for operators of precision grinders of practically all kinds, as well as for foremen, students, apprentices, and instructors. The data covers work centers and drivers; work rests; the diamond; wheel dressing and truing; mounting and balancing the wheel; wheel coolants; lubrication; multiple V-belt drives; wheel-spindles and bearings; wheel feed; wheel width; speed of work carriage; work and wheel speeds; the grinding wheel; chatter, etc. Available to those interested upon request. 1

Tantalum-Tungsten Carbide Tools and Blanks

VASCOLOY-RAMET CORPORATION, North Chicago, Ill. Catalogue listing twenty-two typical styles of Vascoloy-Ramet single-point tools. Valuable features of the catalogue include a grade selector chart recommending the grade of Ramet carbide for practically every cutting condition in steel, cast iron, and abrasive materials; tables for calculating weights of various shapes of Vascoloy-Ramet blanks; and tables for computing costs of standard tools and blanks and special blanks. 2

Pneumatic Chucks and Vises

HANNIFIN MFG. CO., 621-631 S. Kolmar Ave., Chicago, Ill. Bulletin 58, descriptive of Hannifin pneumatic, double-acting, rotating cylinders for chuck operation, embodying an adjustable "Leakproof" piston packing. Circular 59, illustrating and describing Hannifin pneumatic vises for use on the bench, drill press, and milling machine. 3

Industrial Cleaning Methods

OAKITE PRODUCTS, INC., 26 Thames St., New York City. 5-page treatise published as part of the *Oakite News Service* and entitled "Cartridge Case Making Rests on Precision Methods." It concisely describes tank cleaning and automatic washing machine methods used in the production of cartridge cases for artillery shells and similar ammunition. 4

Speeding Up Pressing Operations

DENISON ENGINEERING CO., 102 W. Chestnut St., Columbus, Ohio. Bulletins PH 200 and 201, containing information of value to users of straightening and assembling presses on how to obtain increased production from these machines by retooling them for bending, broaching, and other operations. Details of tooling shown by drawings. 5

Sealing Solutions for Castings

BAKELITE CORPORATION, UNIT OF UNION CARBIDE AND CARBON CORPORATION, 30 E. 42nd St., New York City. Folder explaining how porous or leaky metal and alloy pressure castings can be reclaimed by the use of Bakelite sealing solutions. Instructions are given for the impregnation of the castings and baking operations. 6

Forged-Carbide Tools

FORGED CARBIDES, INC., 40-30 Twenty-third St., Long Island City, N. Y. (Exclusive Distributor, Luria Steel & Trading Corporation, 233 Broadway, New York City.) Circular describing a new type of cutting metal known as forged carbide, said to have a hardness midway between that of a diamond and regular carbide. 7

Certified Steels

JOSEPH T. RYERSON & SON, INC., Chicago, Ill. One-hundredth anniversary steel stock list (1942-1943), consisting of 268 pages of catalogue data listing more than 11,000 different kinds, sizes, and shapes of steel bars, shapes, plates, sheets, tubing, and alloy and tool steels carried in stock for immediate shipment. 8

Electro-Hydraulic Boring Machines

B. M. ROOT CO., York, Pa. Circular illustrating and describing the new Root line of electro-hydraulic boring machines, especially adapted for use in making ammunition and packing boxes. Bulletin 123, describing various operations in producing ammunition boxes on these machines. 9

Instruments for Inspecting Finished Parts

SCHULTZ & ANDERSON CO., 174 Ferry St., Newark, N. J. Circular illustrating and describing an instrument for detecting cracks, scratches, and tool marks on dies and for inspecting screw machine products, fine accurate work, and other finished parts in machine and tool shops. 10

Motor Maintenance Equipment

IDEAL COMMUTATOR DRESSER CO., 1011 Park Ave., Sycamore, Ill. Circular descriptive of a new cleaning stone for quickly and easily removing excess film and dirt from commutators caused by heavy, continuous power loads. The circular also illustrates commutator resurfacers and precision grinders. 11

Saw Blades

E. C. ATKINS & CO., 416 S. Illinois St., Indianapolis, Ind. Bulletin giving list prices and specifications covering this company's line of hacksaw and metal saw blades.

One cover of the catalogue carries a reproduction of a large government poster encouraging the purchase of Defense Stamps. 12

Master Feed-Fingers for Automatic Screw Machines

GREEN MFG. CO., 652 South St., Rockford, Ill. Catalogue describing the distinctive features of the Green master feed-finger for automatic screw machines, which is provided with flexible inserts to accommodate work of various sizes and shapes. 13

Aero-Thread Screw System

AIRCRAFT SCREW PRODUCTS CO., INC., 47-23 Thirty-fifth St., Long Island City, N. Y. Specification Sheet No. 234, containing data on the Aero-Thread screw thread system of value to design engineers and others who are applying this system to their products. 14

Belt Grinding

PORTER - CABLE MACHINE CO., Syracuse, N. Y. Booklet entitled "Wet-Dry Belt Grinding," describing important points to be observed in belt grinding, both by the wet and dry process, and illustrating various belt grinding machines made by this company. 15

Grinding Wheels

BAY STATE ABRASIVE PRODUCTS CO., Westboro, Mass. Catalogue entitled "Valuable Facts about Bay State Grinding Wheels," containing a fund of useful information on the selection of grinding wheels for various kinds of work and different operations. 16

Bearings for Military Use

TIMKEN ROLLER BEARING CO., Canton, Ohio. "Defense Supplement," containing data on basic dimensions, rating, and price of 687 bearings suitable for military use. Copies are available to those interested if requested on a company letter-head. 17

Material-Handling Equipment

CLEVELAND TRAMRAIL DIVISION OF THE CLEVELAND CRANE & ENGINEERING CO., 1157 E. 283rd St., Wickliffe, Ohio. Booklet 2008-A, containing engineering and application data covering Cleveland Tramrail overhead material handling equipment. 18

High-Pressure Hydraulic Operating Valves

GALLAND - HENNING MFG. CO., 2753 S. 31st St., Milwaukee, Wis. Folder illustrating and describing Nopak balanced three- and four-way "Hy-Pressure" hydraulic operating valves for hydraulic pressures over 500 pounds. 19

Drills and Reamers

WHITMAN & BARNES, 2108 W. Fort St., Detroit, Mich. 32-page booklet entitled "Drill and Reamer Facts," illustrating and describing the design and construction of twist drills and reamers, and giving information about their efficient operation. 20

Thread Milling

GORDON-R CO., 627 Washington Square Bldg., Royal Oak, Mich. Circular entitled "Just Push the Button," describing the operating principles and advantages of the Plan-O-Mill, designed to perform automatic form-milling and thread-milling operations. 21

Electric Heating Units and Controls

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Catalogue 28-000, containing specifications, selection guide, etc., covering Westinghouse electric heating units and controls for industrial applications. 22

Shearing and Trimming Machines

QUICKWORK-WHITING DIVISION OF WHITING CORPORATION, 15673 Lathrop Ave., Harvey, Ill. Circular QW-106, descriptive of Quickwork-Whiting metal-working machinery, including rotary shears, power hammers, and stamping trimmers. 23

Flexible Couplings

LOVEJOY FLEXIBLE COUPLING CO., 5021 W. Lake St., Chicago, Ill. Catalogue giving details of the con-

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To Obtain Copies of New Trade Literature

listed on pages 158-160 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Name ..... *Position or Title* .....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm .....

Business Address .....

City ..... *State* .....

[SEE OTHER SIDE]

struction and application of L-R flexible couplings. Tables of specifications, dimensions, and prices for the various types are included. 24

Variable-Speed Devices

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis. Bulletin B6013A, describing how to step up production from available machine capacity by the use of the Vari-Pitch speed changer. Diagrams, operating data, and tables for selecting the right size unit are included. 25

Variable-Speed Control

REEVES PULLEY CO., Columbus, Ind. Catalogue G-423, entitled "More Output for Defense," showing twenty-six examples of how production is being speeded up by accurate, infinite, variable-speed control. 26

Shakeproof Fastening Devices

SHAKEPROOF, INC., 2501 N. Keeler Ave., Chicago, Ill. Catalogue 42, containing 140 pages of detailed information on Shakeproof fastening devices, such as lock-washers, spring washers, locking screws, precision stampings, etc. 27

Gears

FARREL-BIRMINGHAM CO., INC., 377 Vulcan St., Buffalo, N. Y. Booklet entitled "Farrel Marine Gears in Action," illustrating and describing Farrel reduction gear drives now in service on principal types of ships. 28

Grinding Wheels

NORTON CO., Worcester, Mass. Booklet entitled "A Primer on Grinding Wheel Safety," containing a brief presentation of important points to be observed by operators of grinding machines to insure safe operation. 29

Pluramelt Products

ALLEGHENY LUDLUM STEEL CORPORATION, Pittsburgh, Pa. Bulletin entitled "Pluramelt Conserves Vital Alloys," describing the use of Allegheny metal facing alloys integrally bonded to plain steel by the Pluramelt process. 30

Laminated Shims

LAMINATED SHIM CO., INC., Glenbrook, Conn. Catalogue describing the laminated shim made by this company, and its use in fitting machine parts in the original assembly, as well as in making service adjustments. 31

Optical Grinding and Polishing Machines

GEORGE SCHERR CO., INC., 128 Lafayette St., New York City. Bulletin illustrating and describing the Lehmann line of optical grinding and polishing machines for use in optical plants, instrument and aircraft shops, etc. 32

Turret Lathes

SOUTH BEND LATHE WORKS, 771 E. Madison St., South Bend, Ind. Condensed catalogue 67-T, descriptive of the South Bend 2-H turret lathe. 33

Gear Shapers

FELLOWS GEAR SHAPER CO., Springfield, Vt. Catalogue illustrating and describing the Fellows straight-line, high-production gear shaper with rack type cutter for generating fine-pitch external spur and helical gears. 34

Electric Heaters

GENERAL ELECTRIC CO., Schenectady, N. Y. Catalogue GED-650B, listing the complete line of G-E electric heaters, heating devices, and heat control equipment for industrial use. 35

Flame-Cutting Equipment

AIR REDUCTION, 60 E. 42nd St., New York City. Booklet describing the Airco "45" high-speed machine cutting tip, said to increase flame-cutting speeds from 20 to 30 per cent. 36

Cemented-Carbide Tools

CARBIDE FABRICATORS, Berkley, Mich. Catalogue listing complete specifications and prices covering this company's line of standard cemented-carbide tools. 37

Non-Sparking Tools

AMPCO METAL, INC., Milwaukee, Wis. Leaflet on Ampco non-sparking safety tools. 38

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 161-182 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number at the end of each description on pages 161-182 — or write directly to the manufacturer, mentioning machine as described in March MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Reed-Prentice Improved Milling Machine

A No. 4 vertical milling machine in which important improvements have been incorporated has just been introduced to the metal-working industry by the Reed-Prentice Corporation, Worcester, Mass. The bed of this machine provides a long support for the square gibbed ways on the table, which have sufficient area to keep the unit pressure to a minimum under heavy loads. The ways are pressure-lubricated, and are protected from chips and dirt by a sheet-metal cover which slides in a special track when the table is traversed on the bed.

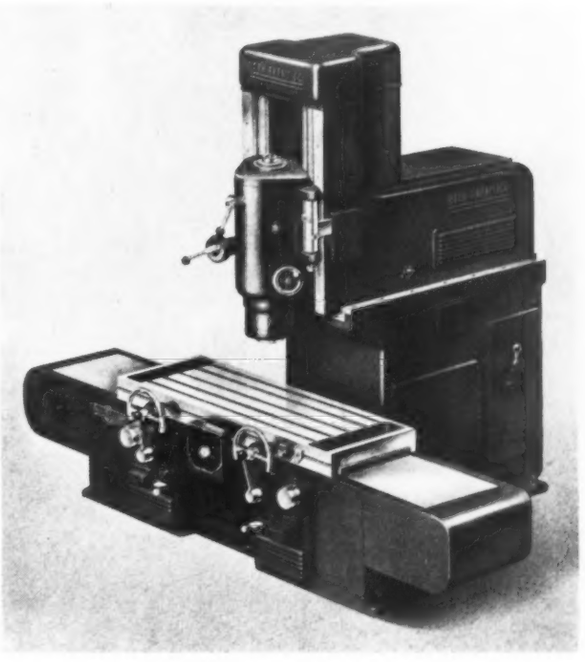
The column houses the hydraulic units in its base, and carries the cross-slide on pressure-lubricated ways. The cross-slide supports the vertical head. Large doors provide easy access for servicing the machine. The spindle of the vertical head is mounted in widely spaced precision taper roller bearings at the nose or lower end and in a double-row taper roller bearing at the upper end, the latter bearing being mounted to allow for axial expansion or contraction of the spindle. All gears in the head are of the helical type, and are lubricated from a pump that supplies oil to all moving parts. A lock prevents the spindle from being started unless it is released.

A motor on top of the cross-slide provides rapid vertical traverse of the head up or down, the movement being controlled from a push-button panel. Hand movement is also obtainable through a handwheel. Power down feed can be supplied as an extra. Adjustable dogs are provided for each of the four positions of the turret stop. These dogs trip a limit switch which stops the rapid-traverse motor and brings the head to rest on a positive stop-block. Accurate setting is accomplished by means of a dial indicator.

The spindle-drive gear-box is mounted on the cross-slide and has taper roller bearings on all shafts and helical gears. A built-in pump supplies oil to all gears and bearings. One preselector lever, used in conjunction with the back-gear in the head, controls eighteen different spindle speeds ranging from 30 to 1200 R.P.M. A lever to the right of the operator, connected to a hydraulic motor, controls the feed and rapid traverse of the table in both directions, the upright position of the lever being the "stop" position. Any feed from 1/2 inch to 37 inches per minute can be preselected on a dial below the handlever. Rapid traverse at the rate of 180 inches per minute is engaged by moving the lever beyond the feed position in either direction.

The airplane type handwheel is a separate control, connected with the same hydraulic motor, for operating the table at feed rates up to 10 inches per minute, regardless of the setting of the feed selector dial. Rotating this handwheel increases the rate of travel, and when released, it will return to the neutral position. The handwheels project above the top of the table, but can be quickly swung forward to clear overhanging work. This type of control replaces the conventional handwheel and enables the operator to move the table in either direction for setting purposes in increments as fine as 0.001 inch. Both the table and cross-slide can also be operated by hand through a crank-handle. Sockets in front of the machine provide for hand movement of the table and slide.

A duplicate set of controls to the left of the operator, connected to another hydraulic unit, is used to control the cross-slide. Thus, both table and cross-slide can be operated independently or simultaneously at any feed rate within their range. Dogs at the



Reed-Prentice Improved Vertical Milling Machine

To obtain additional information on equipment described on this page, see lower part of page 160.

front of the table and on the left-hand side of the cross-slide provide for automatically stopping either table or cross-slide movement.

The table dial at the right of the operator consists of two disks. The outer one, graduated in inches, shows the total travel of the table in inches, while the inner disk shows the travel in increments of 0.001 inch. The dial at the left of the operator shows the travel of the cross-slide in inches and in increments of 0.001 inch. Table and cross-slide movements are obtained through a lead-screw operated from hydraulic motors which provide the flexibility of the fluid drive in combination with the positive action of a screw. Electric motors for spindle drive and feeds and the vertical traverse motor for the head are controlled from a central push-button station.

A 24-inch rotary table can be supplied as extra equipment. The 10-H.P. driving motor for the spindle is coupled directly to the driving gear-box through a flexible coupling. The drive to the hydraulic pump from the 5-H.P. motor is by means of a silent chain.

The table has a working surface of 24 by 70 inches, and is 7 1/2 inches thick. The longitudinal travel of the table is 48 inches, and the cross-travel of the ram 24 inches. The vertical travel of the head is 12 inches. Maximum distance from top of table to spindle nose is 24 inches, and minimum distance 12 inches. The throat depth is 33 inches. The machine occupies a floor space of 137 by 110 inches, is 107 inches high, and weighs 18,000 pounds. 51

"Sine Line" Machine for Checking Spiral-Gear Leads

The Michigan Tool Co., 7171 E. McNichols Road, Detroit, Mich., is adding to its line of gear-checking equipment a Model 1205 "sine line" lead-checking machine. This new machine is designed to check right- and left-hand spiral-gear leads with spiral angles from zero to infinity. It is of the adjustable sine-bar type and can be used with the Michigan gear-checking recorder if desired. The standard machine has a capacity for testing gears of any size up to 18 inches in diameter within a center distance capacity of 24 inches. The machine can be obtained in bed lengths of 36 and 48 inches at extra cost.

The operating mechanism, including the sine bar, is completely enclosed and protected against dust. All adjustments are made at a convenient working height, including setting of the sine bar. The machine has two tables—a transverse table enclosed in the left end of the machine which carries the sine bar, and a longitudinal indicator table which carries the indicator.

The sine-bar table is arranged to reciprocate crosswise, while the longitudinal table moves lengthwise, parallel with the face to be checked. The sine-bar table, when moved back and forth, rotates the spindle on which the gear to be checked is mounted. When the sine bar is set parallel to the axis of the machine, gears of infinite lead —equivalent to straight spur gears —can be checked, since longitudinal movement of the indicator table produces no movement of the sine-bar table. Any angular position of the sine bar that produces movement of one table also produces a corresponding movement of the other table and rotation of the spindle.

The correct setting of the sine bar is made by the use of either micrometers or gage-blocks placed between the end of the bar and

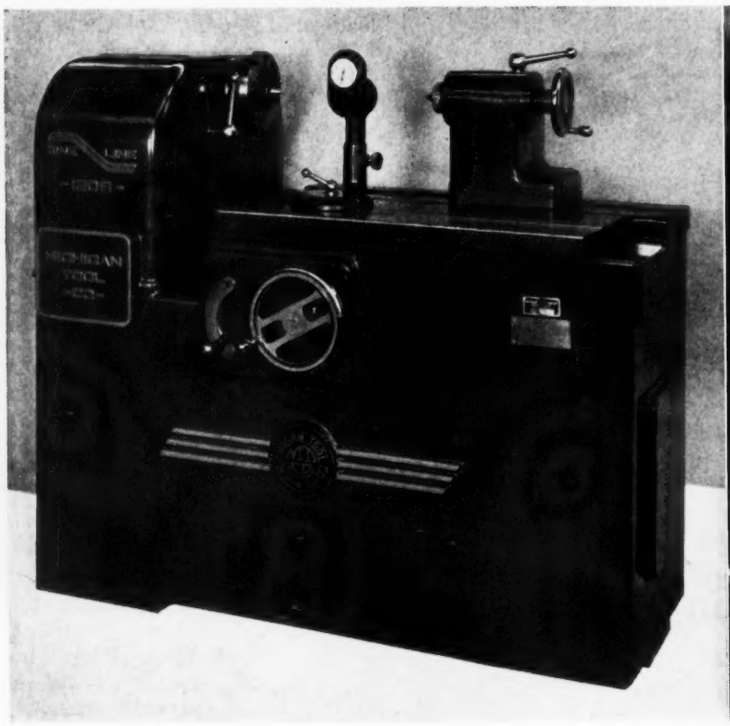


Fig. 1. "Sine Line" Spiral-gear Lead-checking Machine Made by Michigan Tool Co.

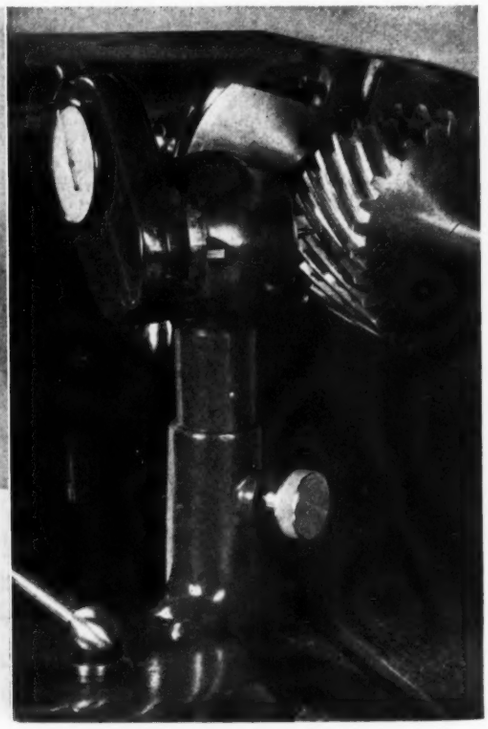


Fig. 2. Indicator Pedestal of Machine Shown in Fig. 1

To obtain additional information on equipment described on this page, see lower part of page 160.

special 1-inch diameter locating pins mounted in the transverse table. Complete flexibility is provided for checking either face of each gear tooth and at any depth, whether right- or left-hand spiral.

Movement of the indicator along the face of the gear is accomplished by two controls at the front of the machine. The lever to the left of the handwheel determines whether the sine bar or the indicator table is the driving member, dependent upon the angle of lead. The handwheel reciprocates either or both tables according to the desired sine-bar setting. The indicator is graduated to 0.0001 inch. 52

Colonial Dual-Ram Broaching Machine

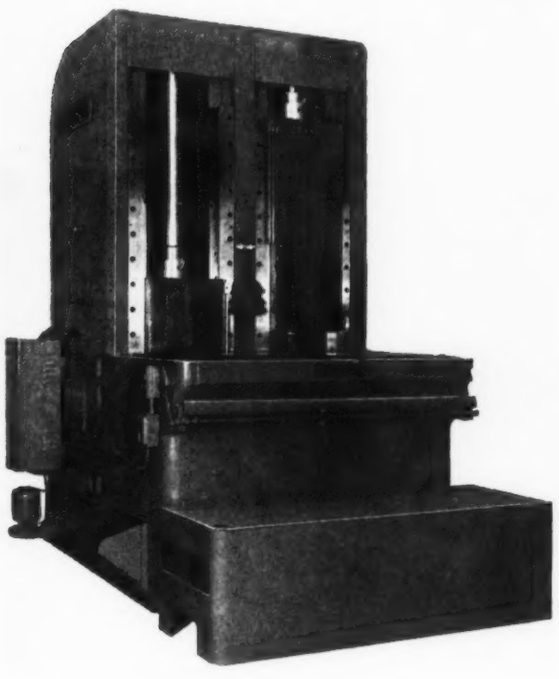
The Colonial Broach Co., 147 Jos. Campau, Detroit, Mich., has developed a new standard line of dual-ram broaching machines known as the VAD series. The eleven sizes range in capacity from 3 tons and 36-inch stroke up to 25 tons and 66-inch stroke. The new machines are of streamline design, and have work-tables and rams of larger size than the previous models. Peak capacities have also been increased to provide ample reserve power when operating at normal rated capacities. These machines are especially suitable for use where extremely high production is required, and where one operator can handle the feeding and removal of a part from one ram while the other ram is working.

The construction of the receding table mechanism has been improved and simplified to allow for the installation of chip wipers to protect the bearing surfaces of the moving platen. The new design of the table provides a finish-machined pad on the front for mounting auxiliary units, such as cams, and for automatically operating clamps, locks, and supporting jacks on fixtures. At slight additional cost provision can be made for clamping workpieces in position in a fixture by utilizing the hydraulic system of the machine. A patented cam lock and narrow center guide for the receding table mechanism is incorporated in these new machines.

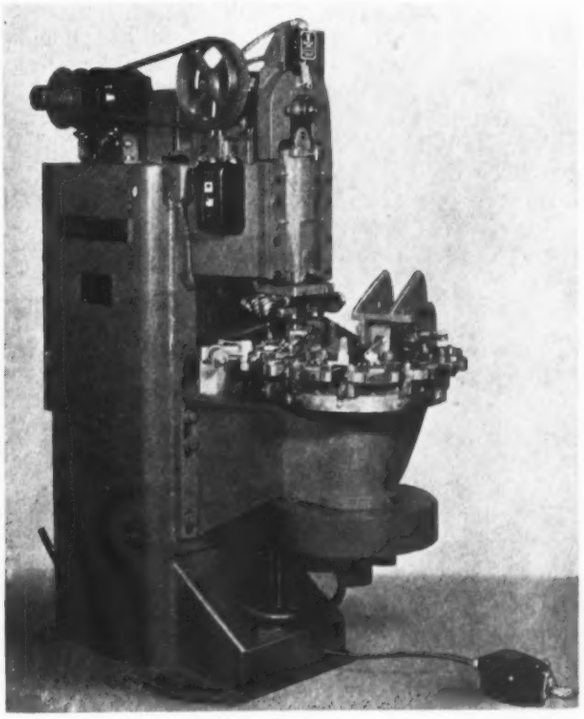
The length of travel of the receding table has been increased in the larger machines of this line. A wider range of applications, with increased safety of the operator is obtained, especially with broaches having deep or irregular contours. Both the dual safety control and the emergency knee-operated bar for quick stopping are supplied on all machines. Operation of the rams is continuous, with one ram traveling down while the other is returning to the starting position. Chip room and coolant capacity have been increased without adding to the over-all height of the machines. All machines are equipped with heavy-duty, large-volume coolant pumps. 53

Thomson-Gibb Welder with Dial Feed

The latest development in a series of resistance welding machines brought out by the Thomson-Gibb Electric Welding Co., Lynn, Mass., for attaching baseplates or sealing disks to shell bases is shown in the accompanying illustration. This machine is basically a Thomson motor-driven welding press with a 75-K.V.A. transformer and a ten-station automatic dial feed. The shells and disks are loaded by hand, but thereafter the operation is entirely automatic, including ejection



Colonial Dual-ram Broaching Machine Built in Capacities of Three to Twenty-five Tons



Dial-feed Welding Machine Developed by the Thomson-Gibb Electric Welding Co.

To obtain additional information on equipment described on this page, see lower part of page 160.

of the welded work on a chute or conveyor.

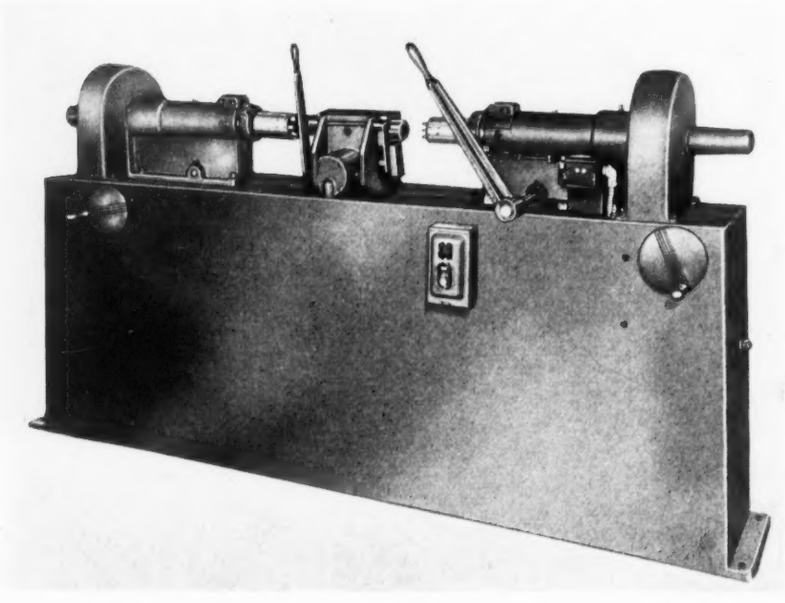
Accurate positioning is insured by a clamping mechanism which locates the members to be welded together and applies a positive gripping action as each station reaches the welding position. A tripping device opens the clamps and ejects the work before each station returns to the loading position. When directly in front of the operators, the vertical and horizontal clamps are in the wide open position, ready for easy loading. The operation is continuous, but subject to instant control by a foot-operated switch. 54

Pines Double-End Centering or Burring Machine

A double-end centering or burring machine has recently been developed by the Pines Engineering Co., Inc., 123 Main St., Batavia, Ill., for use in simultaneously profiling both ends of short tubes used in incendiary bombs. The machine illustrated will take tubes 10 3/4 inches long. These tubes are loaded into the automatic chuck by means of a positioning device, operated by a lever which is also used to automatically eject the part from the chuck after the profiling operation is completed.

The chuck for holding the tubes is operated automatically by means of an air cylinder built into its base. The forward travel of the spindles is controlled by adjustable stops which determine the amount of material removed and the finished length of the piece. A separate motor and variable-speed drive are provided for each spindle. These machines are also built to accommodate longer lengths of tubing or rods, using two chucks, one chuck and spindle being adjustable to suit the length of the work.

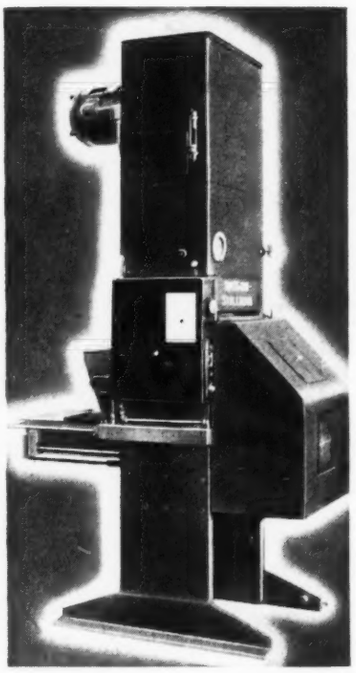
The tools supplied with this machine take standard 3/8-inch square cutter bits which are inserted in the end of the holder through square openings and held in place by set-screws. These bits are ground to produce the required profile on the ends of the tube. A simple boring or chamfering operation or any other type of end finishing operation can be performed. The machine base is constructed from welded steel plate and houses the driving control mechanism. 55



Pines Centering Machine Equipped for Profiling Both Ends of Incendiary Bomb Tubes Simultaneously

Watson-Stillman Automatic Molding Machine

An improved 75-ton, fully automatic, compression molding machine has been developed by the Watson-Stillman Co., Roselle, N. J. This machine is designed to mold plastic products at higher speed than was possible on previous machines of the same capacity. Another improvement is the provision for making all settings for time periods, materials, quantities, and pressures independently from a single control planel.

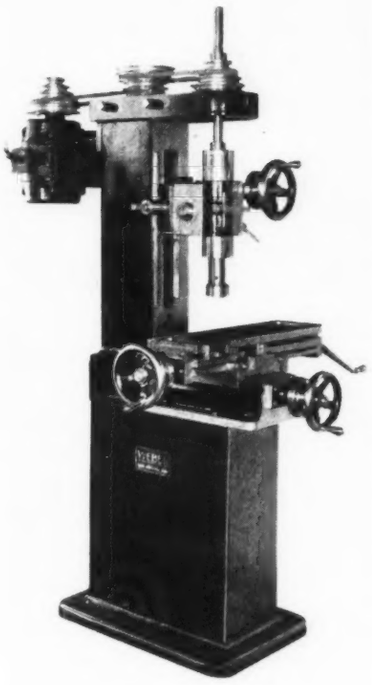


Automatic Molding Machine Built by the Watson-Stillman Co.

The machine has a 10-inch stroke, an approach speed of 210 inches per minute, a pressing speed of 3.3 inches per minute, and a return speed of 140 inches per minute. The die space is 18 by 18 inches, and the maximum height of each die half is 8 inches. The bottom and top ejectors are suitable for all materials adapted to compression molding. Operation is by a 5-H.P. pump. The machine requires a floor space of 6 by 3 feet, and is 10 feet 4 inches high.

A hydraulically operated feeder places predetermined amounts of material in each mold cavity. The molds are closed under low pressure, and high pressure is applied automatically at a predetermined time. Molds can be degassed if necessary. The molded pieces are stripped and blown down a chute to an automatic weighing scale. An alarm sounds if the machine fails to strip a piece of work from the die. 56

To obtain additional information on equipment described on this page, see lower part of page 160.



Weber Milling Machine and Jig Borer

Weber High-Speed Vertical Milling Machine and Jig Borer

A high-speed, vertical milling machine and jig borer designed to accommodate small work, such as dies, jigs, fixtures, models, molds for plastics, and metal patterns, and to perform all types of laying out, drilling, milling, and boring operations is being manufactured by the Weber Tool Co., 4200 Whiteside St., Los Angeles, Calif. The table of this machine is equipped with two adjustable stops and a lock. A lock is also provided on the saddle.

The spindle is fitted with precision ball bearings and the spindle pulley runs on two separate ball bearings, thus eliminating strain on the spindle. The spindle nose is machined to take collets that will receive 3/8- to 7/8-inch straight-shank double-ended end-mills. Two sleeves are furnished to receive No. 3 Morse taper, and one sleeve for No. 8 B & S taper.

A 5-inch micrometer dial and worm-gear arrangement controls the spindle feed to 0.001 inch. The table is 9 by 36 inches, and has a longitudinal travel of 22 inches and a crosswise travel of 14 1/2 inches. The distance from the top of the table to the spindle end is 18 inches, and the sliding head has a movement of 16 inches. The spindle has a travel of 7 inches. There are fifteen spindle speeds covering a range of 100 to 2000 R.P.M. Spindle feeds of 0.001, 0.002, 0.005 and 0.008 inch are available.

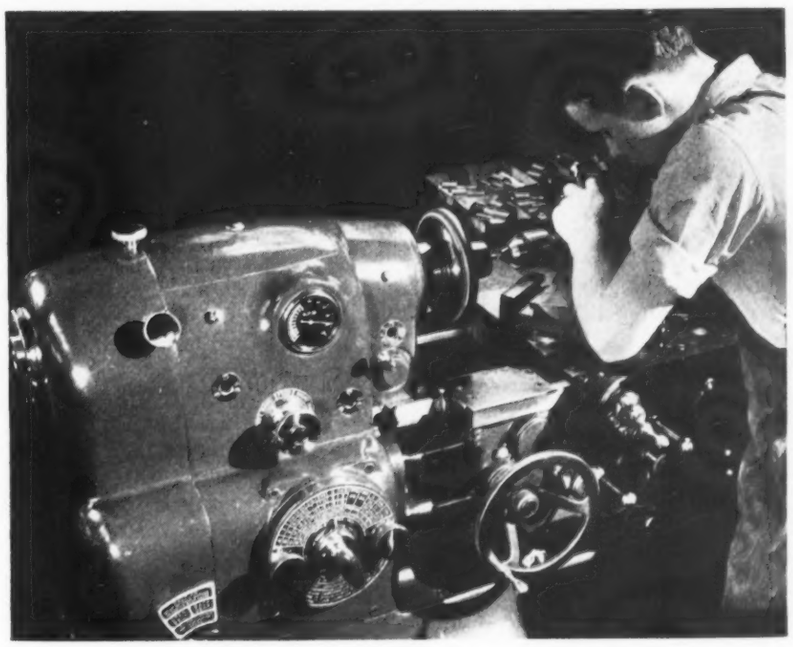
The height from the floor to the table top is 42 inches, and the over-all height over the pulleys is 84 inches. The machine requires a floor space of 36 by 48 inches. — 57

Wide Speed Range Drive for Monarch Tool-Room Lathe

In order to obtain the wide range of speeds desired for its 10-inch tool-room lathe, the Monarch Machine Tool Co., Sidney, Ohio, is now equipping this machine with an all-electric adjustable-speed drive developed by the Reliance Electric & Engineering Co., Cleveland, Ohio. This new drive consists of a control unit with start, stop, and reset buttons, a 3-H.P. direct-current motor which is easily connected to the lathe through a pulley keyed to the spindle, a speed adjusting rheostat, and a master lever located directly below the spindle for starting, stopping, and reversing the lathe motor. All this electrical equipment, together with the control panel containing forward and reverse contactors controlled from the master lever on the headstock, is concealed inside the base of the lathe. Spindle speeds, indicated in revolutions per minute, are shown by a magnet type tachometer flush-mounted on the front of the headstock.

The speed, as set by the rheostat, is relatively constant and does not change greatly with a change in load. When the maximum voltage is applied to the armature of the motor, at maximum speed, the speed variation from zero to full load is about 10 per cent. A 6 to 1 ratio back-gear incorporated as an integral part of the driving motor provides additional cutting power at the lower speeds. The direction of spindle rotation can be reversed when running at top speed. The over-all range of spindle speeds is from 4 1/2 to 2500 R.P.M. The change from direct to back-gear drive should be made only when the spindle is stopped.

In operating the adjustable-speed drive, the control unit is started at the beginning of each work period and is shut down only when the work is completed. A



Monarch Tool-room Lathe Equipped with All-electric Adjustable-speed Drive

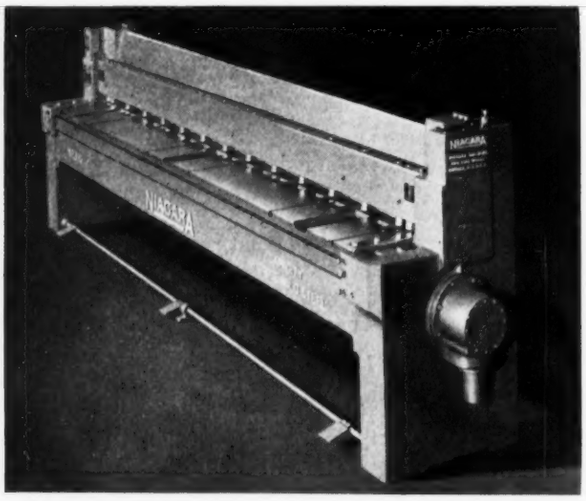
To obtain additional information on equipment described on this page, see lower part of page 160.

start and stop station for this unit is located to the left and immediately below the bed of the lathe. A small green pilot light remains on as long as the control unit is running. The stop-button has a large mushroom head, so located that the operator can actuate it with his knee.

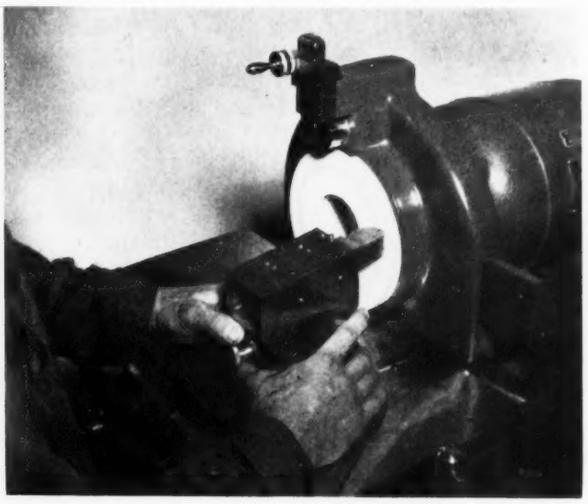
The starting of the control unit does not, however, start the motor that drives the lathe spindle. This motor is separately started and stopped in either the forward or reverse direction by a hand-lever, which must be in the center of "off" position in order to start the control unit. Its operating speed is controlled by a knob at the front of the lathe. The speed of the spindle can be increased or decreased through the full range of 2500 R.P.M. A sustained overload on either the driving motor or the adjustable-speed control unit causes the spindle to stop automatically. Restarting is accomplished by a reset button. 58

Of particular importance from the standpoint of long tool life is the fact that the relief and clearance angles provided by this method are constant at all points on the cutting edge with respect to the direction of the in-feed of the tool. The correct rake, whether back rake or a combination of back and side rake, is quickly ground in another simple operation. While the formula for determining the correct relief and clearance angles is of no value without the Bura-way grinder, the machine can be used without the formula and can be operated by an unskilled worker after a few hours instruction and practice.

The form of the tool point is determined by a cam which is attached to the tool-holder and acts as a guide for the operator as he slides the tool-holder on the table in a rotating motion while bringing the tool in contact with the wheel. The cam is made on the same machine, being developed with an attachment by means of which the form of a master tool is transferred to the cam, which thereafter permits the exact duplication of the original tool in any desired quantities. 60



Niagara Power Squaring Shears



"Bura-way" Tool-grinding Machine

Niagara Power Squaring Shears

The Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., have recently added to their line of power squaring shears a new series model designated No. 3. Improvements have been incorporated in this model to obtain greater shearing accuracy, higher production, and freedom from "down" time.

The cutting of sheared edges and narrow strips that are straight and parallel to within a few thousandths inch can be accomplished on this machine. The operating speed is 80 strokes per minute. High-production squaring and trimming are also assured by the instant-acting Niagara sleeve clutch and quick-acting, ball-bearing, self-measuring back gage. Reduction of fatigue in handling sheets and cut-off material is another advantage claimed for these shears.

The drive mechanism, including flywheel, gearing, clutch, eccentrics, and connectors, is enclosed and operates in oil to insure long life, low maintenance cost, and safety. The motor is direct-connected to the shears. The machines are built in 4- to 12-foot cutting lengths with capacities for handling 14- to 18-gage material. 59

"Bura-way" Tool-Grinding Method and Machine

Economies and increased machine production are advantages claimed for a new tool-grinding method and machine introduced to the trade as the "Bura-way" by the James Donaldson Co., 230 Park Ave., New York City. The Bura-way method provides a formula for use in establishing the precise relief and clearance angles a single-point metal-cutting tool should have for the work it is to perform. The machine is designed to make possible the grinding of profiles, reliefs, or clearance angles of tools, including the necessary curvature of form tools, in one operation.

Por-Os-Way Grinding Wheel

A new type precision grinding wheel known as the Radiac "Por-Os-Way" is being produced by a patented process by A. P. deSanno & Son, Inc., Phoenixville, Pa. It is claimed that this wheel, when

To obtain additional information on equipment described on this page, see lower part of page 160.

properly used, will take deeper cuts and grind faster than wheels previously available. It is adapted for grinding hard alloys, copper, aluminum, wood, rubber, plastics, and other soft materials.

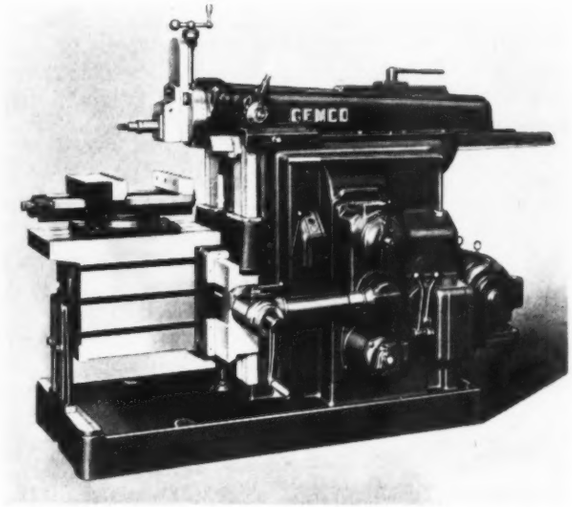
The structure of the wheel, instead of being "sandy" and compact, is more of a "stringy" porous nature resembling a sponge. Air cells allow the air to keep the contact points of the wheel cool. It is claimed that the hard, tough texture holds the corners, so that the wheel requires little dressing. 61

powerful ram with extra large sliding surfaces and bearings; duplex gear ram drive; silent gear drive; wide range of table feed dials for feed stroke and speed adjustments; centralization of controls for easy operation; means for automatically locking stroke and feed mechanisms; and Timken roller bearings throughout. 62

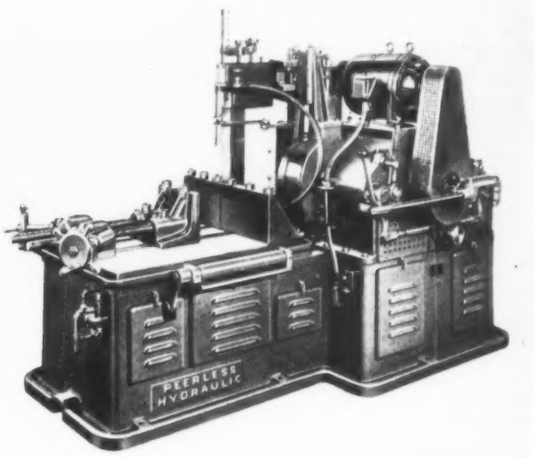
Peerless Vertical-Cutting Power Saw

Various improvements have been incorporated in a new model vertical-cutting power saw brought out by the Peerless Machine Co., 1600 Junction Ave., Racine, Wis. The work-table, 35 inches in length, into blocks for further use by taking a truing cut with the saw. The blocks thus salvaged can be easily reworked for other service.

The vise jaws used for holding small billets, test samples, etc., can



"Gemco" Multi-purpose Shaper Brought out by General Engineering & Mfg. Co.



Peerless Vertical-blade Power Saw Designed for Cutting Large Work

"Gemco" Multi-Purpose Crank Shapers

The General Engineering & Mfg. Co., 1523 S. Tenth St., St. Louis, Mo., has developed a new line of multi-purpose crank shapers known as the "Gemco." These machines are designed for production work. They are available in various sizes, with stroke capacities ranging from 16 to 24 inches, and in plain, production, and universal types.

Among the important features incorporated in these new machines are independent power rapid traverse to the table; universal table; built-in circulating force-feed lubricating system; spray lubrication of all internal parts; self-cleaning automatic oil filter; and a safety feature known as "Lubrigard" which permits operation of the shaper only when there is sufficient lubricating oil.

Other features include high-power vises with graduated bases; permits the handling of large work, which can be lowered to the sawing position and readily removed by means of a crane. Slabs of "Hardtem" tool steel, for example, as long as 24 inches and of any thickness up to 10 inches, can be sawed completely through without turning the work. Elevating stock rollers are provided on both sides of the work-table to facilitate shifting the work. These rollers, as well as the saw blade feed pressure and the blade lift, are operated hydraulically.

This machine is especially adapted for use in cutting tangs in die-blocks, it being possible to position the work at any angle. Only 1/32 inch of stock need be left for finish-planing. The large squarely cut scrap pieces removed by the saw can be used for shearing dies, smaller blocks, strippers, and stripper plates. Dies that have been worn or dulled and chipped from constant use can be quickly shaped be removed when locking clamps are required to hold large pieces. Although the speed at which materials such as Hardtem can be cut depends very largely on the endurance of the saw blade, ordinary materials — such as cold- or hot-rolled steel, bars, or billets—can be cut at speeds up to 7 square inches per minute. A heavy, fully enclosed, oil-bath transmission provides three saw-blade speeds of 50, 85, and 125 strokes per minute. Operation is kept smooth and free from vibration by a balancing cylinder which offsets the weight of the saw frame during its reciprocating motion. A steady flow of coolant applied from the top quickly washes the chips into a tray from which they can be easily salvaged.

The cutting action of the blade can be started or stopped at any point in the work. At the conclusion of the cut, the blade returns automatically to the starting position and stops. Five V-belts fur-

To obtain additional information on equipment described on this page, see lower part of page 160.

nish the drive to the saw frame from a 5-H.P. motor operating at a speed of 1800 R.P.M. The machine has a stroke of 6 inches, uses 14- to 34-inch saw blades, requires a floor space of 56 by 121 inches, and weighs 5400 pounds. 63

Gordon-R Thread- and Form-Milling Machine

The advantages of planetary milling have been combined with the flexibility of hydraulic operation in a new and larger hydraulic Plan-O-Mill which has just been brought out by the Gordon-R Co., 627 Washington Square Bldg., Royal Oak, Mich. This No. 5 automatic form- and thread-milling machine is especially adapted for such work as cylinder heads, spark plugs, breech blocks, propeller hubs and blades, fuel injector parts, shells, etc. It can also be used to advantage in milling oil-grooves in connecting-rods and for a variety of machining operations, including counterboring.

The hydraulic motors on the spindle and quills permit the operator to select the feeds and speeds by merely adjusting dials. No gears or sheaves need be changed, the only other member requiring adjustment being the lead-screw on the spindle. The table is also hydraulically operated. Reversal of the cutting head is button-controlled. A selector switch permits the machine to be operated manually when the automatic cycle of operations is not desired. The time required for the feed cycle ranges from 1 1/2 to 8 minutes.

The machine is designed to combine extreme flexibility with precision to meet machining tolerances of 0.001 inch with a minimum of effort. It is especially adapted to thread- and form-milling operations requiring a high degree of precision where the type of work is subject to frequent change. All motion of the hydraulic Plan-O-Mill is confined to the cutting head, the part itself being held rigidly in its fixture. Large irregular-shaped parts are accommodated as easily as small ones. Parts ranging from 3/4 inch to 20 inches in diameter can be readily handled. Since the cutter returns to the central position at the end of each operation, a number of successive operations, such as threading followed by concentric counterboring, can be performed on this machine in a single work cycle.

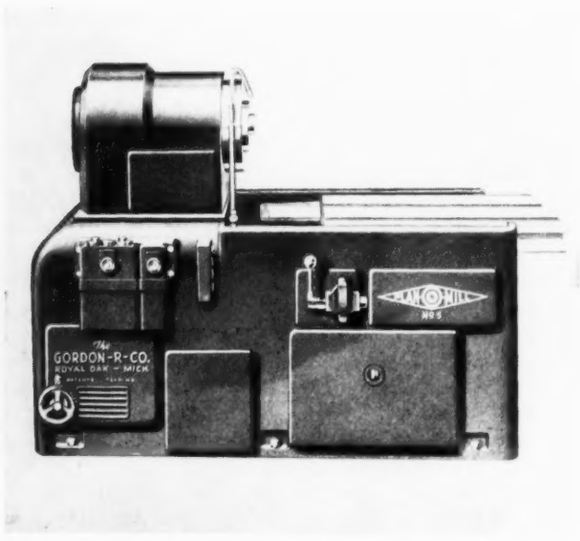
The machine is 61 1/2 inches high, 40 inches wide, and 90 inches long. The table surface is 32 inches above the floor, and is 40 inches long by 28 inches wide. The center line of the head is 14 inches above the table. The maximum travel of the lead-screw is 1 1/8 inches. The 3-H.P., Vickers hydraulic motor provides spindle speeds ranging from 40 to 370 R.P.M. Standard equipment includes an electrical system and a 1- to 7-H.P., 1200-R.P.M. motor. The machine weighs approximately 10,000 pounds. 64

Hammond Cylindrical Polisher

Hammond Machinery Builders, Inc., 1619 Douglas Ave., Kalamazoo, Mich., have developed a Type OD cylindrical polishing machine capable of polishing the outside of cylindrical-shaped work, including rods and tubes ranging from 1/4 inch to 9 inches in diameter. This machine can be equipped with polishing or buffing wheels 16 inches in diameter with a 6-inch face, or it can be provided with belt-stand attachments to adapt it for the use of abrasive belts. The feeding range is from 0 to 50 feet per minute, forward and reverse.

The Vari-Matic feed is motor-driven through a variable-speed drive, allowing various speeds of rotation of the work, as well as variations in the feed. A quick-release lever enables the operator to control the work being fed through the machine by disengaging the work from the face of the wheel. The work-support can be quickly adjusted to accommodate pieces of varying diameters. The wheel cover can be removed quickly to permit changing the wheels or the abrasive belt.

When equipped with buffing or polishing wheels only, the machine requires a floor space of 35 by 52 inches; when provided with a belt stand for the use of abrasive belts, it requires a floor space of 35 by 104 1/2 inches. The weight of the machine is approximately 1800 pounds. 65



Gordon-R Hydraulic Plan-O-Mill

Hammond Cylindrical Polisher

To obtain additional information on equipment described on this page, see lower part of page 160.

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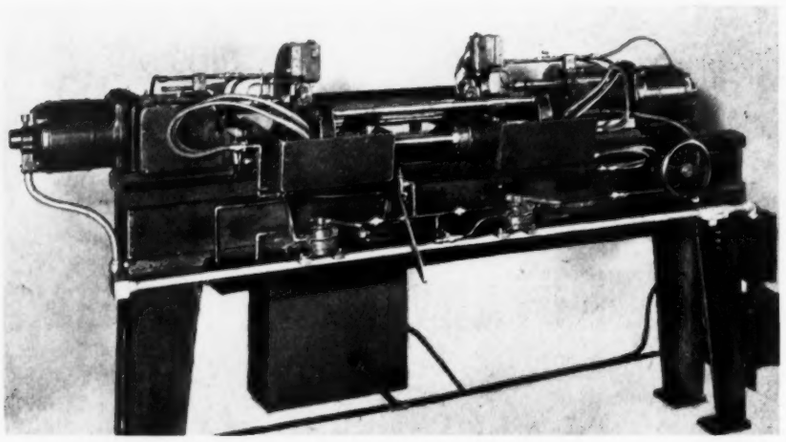


Gun-barrel Recentering Machine Made by W. M. Steele Co.

Steele Barrel Recentering Machine

A machine designed to recenter both ends of gun barrels simultaneously after the bore has been drilled and rough-reamed has just been developed by the W. M. Steele Co., 98-100 Beacon St., Worcester, Mass. The centering operation is performed after locating the barrel from the bore. The new centers produced in this manner will be concentric with the bore, regardless of any eccentricity of the bore with the outside of the barrel.

The machine consists essentially of two automatic, electric motor-driven drilling heads, with horizontal spindles mounted at opposite ends of a long bed. A three-jaw air chuck holds the barrels during the recentering operation.

A pair of barrel loading arms are pivoted on a square shaft at the front of the machine. In the arm ends, and in alignment with and opposed to each other, are two air-driven plungers, the ends of which are tapered and sized to accurately fit the barrel bore. Two adjustable Y-supports for holding the barrels while they are being picked up by the loading arms are located close to the operator at the front of the machine. The barrels are discharged after recentering by opening the air chuck and allowing them to roll out on the draining rack at the back of the machine. 66

Nylen Vertical Automatic Chucking Machine

A 6-inch, vertical, automatic chucking machine designed to permit unskilled labor to turn out precision work at high production rates has been introduced to the trade by the Machine Tool Division, Nylen Products Co., St. Joseph, Mich. This machine will turn and face, bore and face, or machine a contour and dome in one operation. Its rigid construction has been designed for heavy cuts.

The electrically operated and controlled hydraulic feed has a single lever control. The operator simply loads and moves the lever upward. The complete machining cycle, including starting and stopping of the spindle, is then performed automatically. Loading can be quickly accomplished, as there are no obstructions to interfere with the operator's movements. The horizontal and vertical toolblocks operate in conjunction with each other, and considerable variation in adjustment is possible to accommodate different types of work. Work is performed with minimum "down" time.

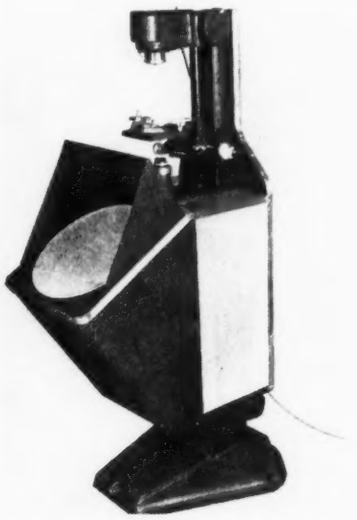
A single operator can handle two or more machines efficiently. It is claimed that women operators can produce precision work after a few hours practice. 67

Nylen Automatic Chucking Machine

Portman Optical Comparator

A new optical comparator has just been placed on the market by the Portman Machine Tool Co., 17 and 19 Beechwood Ave., Mount Vernon, N. Y. This comparator is adapted for use in shop, tool-room, laboratory, or production departments. Objects to be measured, inspected, or compared are simply placed on the work reset member of the stage, thus eliminating the need for numerous staging or holding fixtures.

Outstanding features of this comparator include dovetail ways on all moving parts and an optical system that permits the ready change of image magnifications. The comparator is available with plain type stage unit or it may be equipped with a coordinate stage unit consisting of movable members for sidewise and forward travel. The coordinate stage unit is provided with dial type indi-

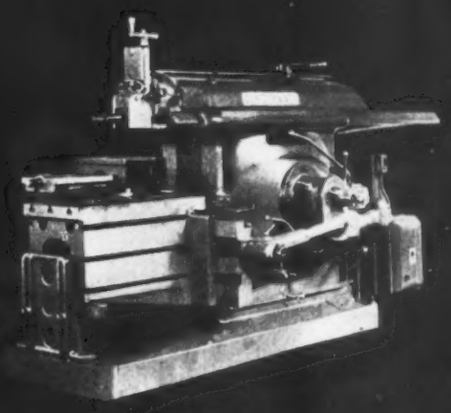


Optical Comparator Made by the Portman Machine Tool Co.

To obtain additional information on equipment described on this page, see lower part of page 160.

Cincinnati
Power Rapid Traverse
SHAPERS

Cincinnati Shapers are built in plain or universal table types from 16" to 36". Their power rapid traverse, multiple cam feeds, automatic oiling, simplified adjustments, and means for quick, easy set-up sell the man who buys for results in the tool room and die shop. Write for Catalog N-1.



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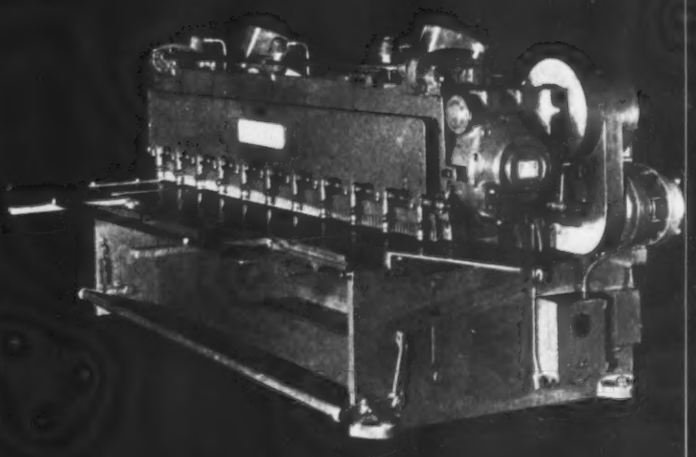
A machine tool for shearing, squaring, notching or slitting metal. Sizes for every requirement from 0.005" aircraft alumium alloy to 1¼" steel plate. All steel construction, hydraulic hold-downs, micrometer ball bearing back gauge, and positive knife adjustment give speed and accuracy. Write for recommendations on your job.



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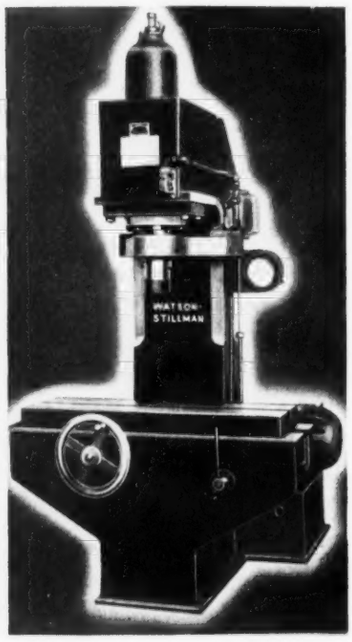
cators reading in 0.001 inch for rapid visual detection of object errors. The reflected image is produced on both clear and ground glass screens. The standard magnifications cover a range of 10 to 100. 68

Watson-Stillman 50-Ton Straightening Press

An improved 50-ton straightening press designed for rapid straightening of rods, bars, tubes, and structural shapes is now being manufactured by the Watson-Stillman Co., Roselle, N. J. A worktable 4 feet long by 14 1/2 inches wide, with a travel of 24 inches governed by a large handwheel, permits the work to be quickly and accurately positioned for the application of straightening pressure.

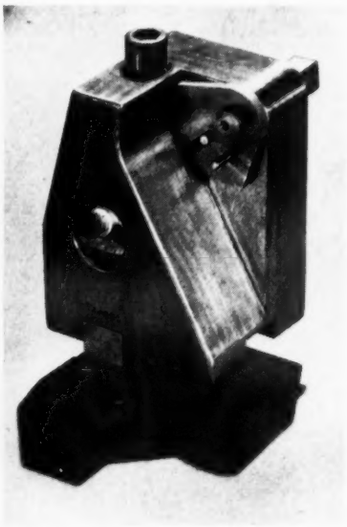
The machine has a 20-inch opening, 14-inch stroke and 12-inch gap. Operation is provided by an Oilgear pump driven by a 5-H.P. motor. The advance speed is at the rate of 109 inches per minute, the pressing speed 18 inches per minute, and the return speed 90 inches per minute. A single handlever furnishes extremely sensitive control. The machine requires a floor space of 5 feet by 4 feet 6 inches, is 8 feet 7 inches high, and weighs about 12,000 pounds. 69



Watson-Stillman Improved Straightening Press

Gisholt Circular Forming Tool Holder

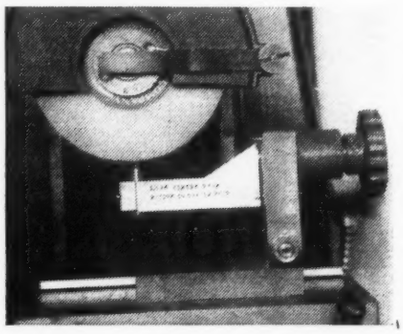
A circular forming tool holder for use on turret lathes has recently been placed on the market by the Gisholt Machine Co., 1209 E. Washington Ave., Madison, Wis. This holder can be used on either the front or the rear of the cross-slide, since cutters can be mounted on either side of the holder. Provision is made for adjusting and locating the cutter, so that the cutting edge can always be properly positioned after grinding. A feature of this holder is the pivot mounting, which can be adjusted for correcting slight inaccuracies of the cutter. 70



Gisholt Forming Tool Holder for Turret Lathes

Schultz & Anderson Radius Dresser for Grinding Wheels

The C-66 radius dresser just brought out by the Schultz & Anderson Co., 174 Ferry St., Newark, N. J., is designed for use on a surface grinder. It is mounted directly on the magnetic chuck for dressing wheels for either convex or concave form grinding to different radii. The device can also be used for dressing wheels for accurate radius grinding where a clearance angle on the radius is required, as in the case of wheels for grinding form turning tools. For this work, the hinge plate of the dresser is set at an angle equal to the clearance angle of the tool. The wheel is then dressed by rotating the diamond back and forth across its face with a handwheel.



Schultz & Anderson Radius Wheel Dressing Device

In dressing a wheel for a 0.250-inch concave radius, a hood inserted in the arm is elevated to such a position that its under side is 0.250 inch above the center line of the spindle. The diamond is raised until the nib touches the under side of the hood, in which position it is locked. The hood is then removed, making the dresser ready for use. If there is to be a clearance angle on the radius, the hinge plate is set to the desired angle. In dressing a wheel for a convex radius, the diamond is set below the spindle center line.

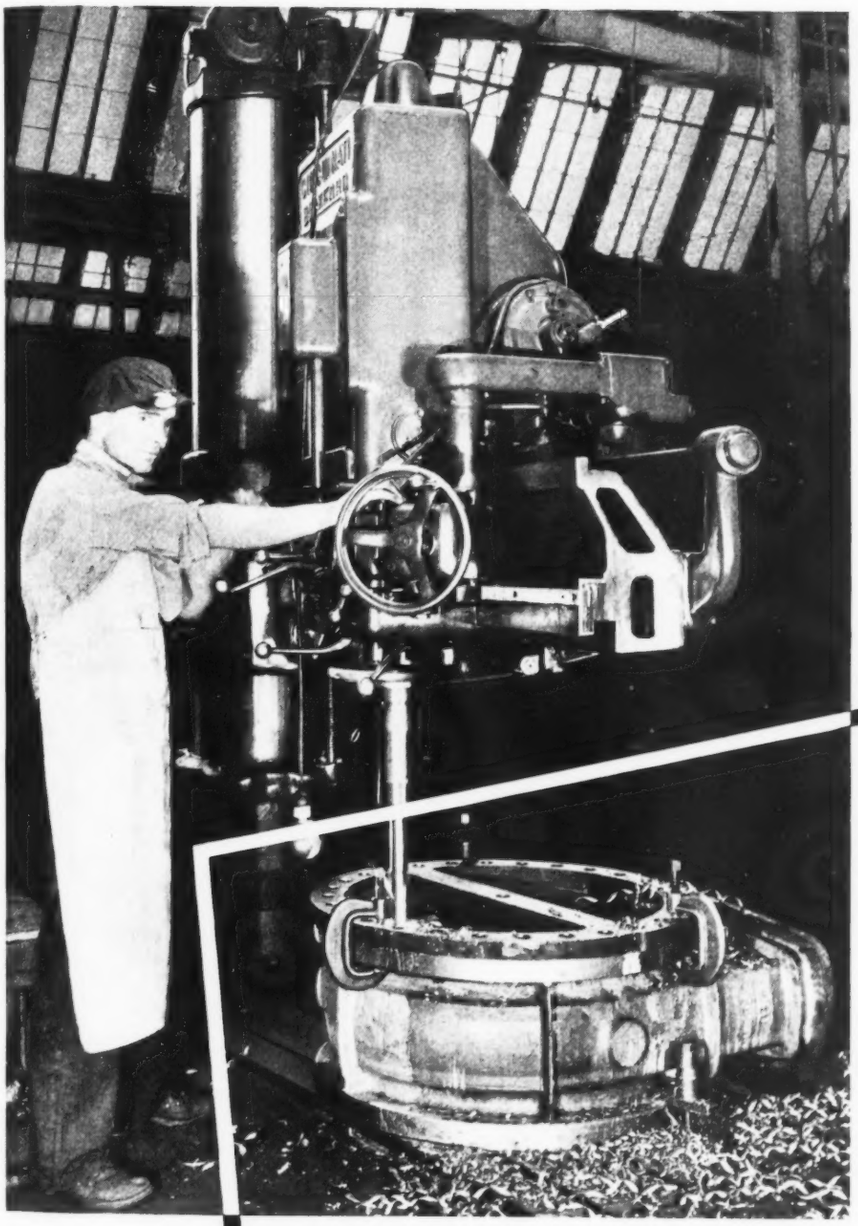
The hinge plate can be set to permit only 90- or 180-degree rotation for either convex or concave radii. A set-screw acting against a ground vee in the arm provides means for holding any diamond up to 3/8 inch in diameter. 71

Kennametal-Tipped Tools for Interrupted Cuts

The McKenna Metals Co., 147 Lloyd Ave., Latrobe, Pa., has brought out four new styles of Kennametal-tipped tools especially designed for interrupted cutting of steel castings and forgings in lathes, boring mills, shapers, and planers. These tools are designed to speed up production in machining steel plates, steel castings, and forgings of irregular shapes. These new Kennametal tools have a negative shear angle of 35 degrees, combined with a positive side rake of 15 degrees.

These tools, known as Kennametal Styles 35, 36, 37, and 38, are

To obtain additional information on equipment described on this page, see lower part of page 160.



. . . and still More Speed

Industry moved pretty fast for "Defense"; now it girds itself for even greater speeds. A Radial Drill which responds to the "all out" demands of industry geared to an unprecedented War production is the Cincinnati Bickford Super Service. In numerous plants batteries of these famous Radials are delivering peak production 24 hours a day, 7 days a week —delivering priceless assets of Accuracy and Absolute Dependability. Cincinnati Bickford designs, aimed at "more-holes-per-dollar", are today proving their value.

- Operations Photograph: Courtesy The Darling Valve & Mfg. Co. Drilling 78 holes, 1⅜" dia. through 2 1/16" cast steel. Floor to floor time 103 min. "More-holes-per-dollar" design nets savings of 15% over machine previously used on this job.

SUPER SERVICE RADIAL

THE CINCINNATI BICKFORD TOOL COMPANY

OAKLEY, CINCINNATI, OHIO, U. S. A.

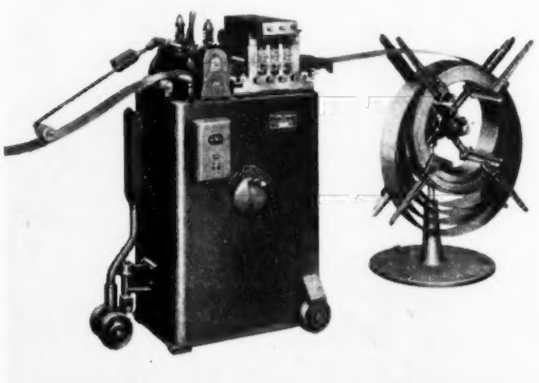
so designed and applied that, in taking interrupted cuts, the work first strikes the cutting edge of the tool at a distance from the extreme point where it is mechanically strong. This permits the chip to be sheared off with a progressive action. These tools are available in both right- and left-hand types. The tips are made longer than those of regular Kennametal tools to compensate for the foreshortening resulting from the 35-degree shear angle. The tips also project above the shank at the back, so that adequate steel or metal is provided under the point. 72

Littell Coil-Stock Feeding and Straightening Machine

A new style continuous feeding and straightening machine designed for feeding coil stock to a punch press has been brought out by the F. J. Littell Machine Co., 4149 Ravenswood Ave., Chicago, Ill. This machine is mounted on a fully enclosed fabricated steel base. It is portable, and is equipped with a control arm for starting and stopping the motor to regulate the loop of stock between the feed and press.

The unit is so arranged that either a five- or a seven-roll straightener can be used. The straighteners are built with all rolls equipped with ball bearings or with the lower rolls power driven. The type of straightener furnished depends on the maximum width and thickness of the stock that is to be straightened.

Specifications include "pinch" rolls 3 1/2 inches in diameter by 8 1/2 inches long for handling stock up to 8 inches wide. The drive is furnished by a 3/4-H.P., three-phase, 1725-R.P.M., 60-cycle, 220- to 240-volt motor through a 6-to-1 variable-speed transmission. The regular speed range is from 10 to 60 feet per minute. The distance from the stock line to the floor is 40 inches; the floor space required, 17 by 36 inches; and the shipping weight, 800 pounds. 73



Coil-stock Feeding and Straightening Machine Brought out by F. J. Littell Machine Co.

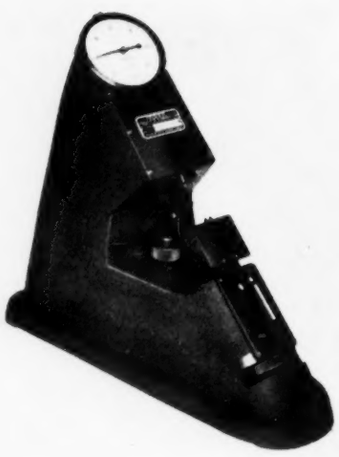


Fig. 1. Federal Three-point Pitch-diameter Gage for American and British Threads

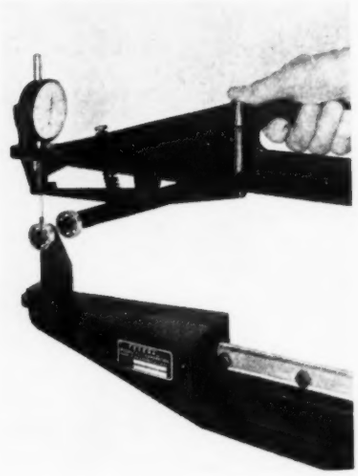


Fig. 2. Federal Portable Gage for Checking Wall Thickness of Shells

Federal Thread and Shell Thickness Gages

A gage designated Model 45B-80 for gaging the pitch diameter of threads, and a portable thickness gage (Model KP-96) for checking the wall thickness of shells, are recent additions to the line of gages manufactured by the Federal Products Corporation, 1144 Eddy St., Providence, R. I.

The pitch-diameter gage, shown in Fig. 1, has been designed to provide a simple mechanical type instrument that can be used to inspect the pitch diameters of all kinds of threads, including British as well as American threads. The gaging process is similar to that of the well-known three-wire method. The two lower locating points are free to adjust themselves laterally independently of any variation in the thread lead. The distance between these two points can be adjusted for different thread sizes. The lower unit is adjustable to take various thread diameters. The upper sensitive contact point, as well as the lower locating points, are all spring-mounted. Inspection within 0.0002 inch is claimed to be possible with this arrangement. The gage is available with either 0.0001- or 0.0005-inch graduations, and will accommodate threads having pitch diameters slightly over 2 inches. One set of gaging points will check all thread pitches from 10 to 80 threads per inch.

The portable thickness gage shown in Fig. 2 for checking the wall thickness of shells, tubes, etc., has a throat depth of 33.3 inches, but can be furnished in other sizes as well. The roller-bearing lower anvil and the roller-bearing pressure unit on the upper arm facilitate handling the gage. The upper roller unit has sufficient tension to hold the lower roller-bearing anvil firmly in contact with the inside surface of the work. The indicator contact point is made of tungsten carbide, and is raised by pressing the plunger in front of the hand grip. The interchangeable steel slide along the lower section guides the shell up to

To obtain additional information on equipment described on this page, see lower part of page 160.

TO LEFT: 39-A Internal —one of nine modern styles of Ex-Cell-O Standard Precision Thread Grinders being widely used today by war production industries.

•

BELOW: Precision grinding internal thread on aircraft part, typical of thousands of war production parts being accurately, speedily and economically ground on Ex-Cell-O precision thread grinders.

TODAY'S PRODUCTION CALLS FOR EX-CELL-O PRECISION

Ex-Cell-O's wide experience in designing and building precision machine tools makes Ex-Cell-O engineers exceptionally familiar with production requirements in today's emergency. Take, for instance, precision thread grinding, almost indispensable in the aircraft and other war industries where hardened threaded parts must be finished to the highest degree of accuracy. Ex-Cell-O engineers have designed nine standard thread grinders—automatics, universals, plain production machines. This variety in style and the flexibility in use of these Ex-Cell-O machines enable a manufacturer to select a standard machine that will meet specifically his exact thread grinding requirements today and provide him with equipment that can be readily and profitably adapted to production of civilian needs tomorrow. Because of their soundness in design, their thoroughness in construction, their simplicity and efficiency of operation, and their modern styling, Ex-Cell-O standard thread grinders are proving the first choice of America's war production industries.

EX-CELL-O CORPORATION • DETROIT

XLO

EX-CELL-O *means* PRECISION

THREAD GRINDING, BORING AND LAPPING MACHINES • TOOL GRINDERS • HYDRAULIC POWER UNITS • GRINDING SPINDLES • BROACHES • CUTTING TOOLS • DRILL JIG BUSHINGS • DIESEL FUEL INJECTION EQUIPMENT • R. R. PINS AND BUSHINGS • PRECISION PARTS

the locating stop. The indicator has a double dial and a telltale hand, and is graduated to read to 0.001 inch. 74

Allis-Chalmers Motors with Protecting Rib

A "safety circle" consisting of a wide, solid rib integrally cast as part of the frame to form an unbroken circle of protecting material around the stator is a feature

Allis-Chalmers Motor of Improved Design

of the new "Lo-Maintenance" motors brought out by Allis-Chalmers Mfg. Co., Milwaukee, Wis. The one-piece cast frame and cast end shields guard the motor from external knocks and abuse.

Electrical materials have been employed more liberally in this new design to make the motor internally and electrically stronger. Improvements in bearing design have been made to insure smoother performance and full-flow lubrication, as well as to facilitate maintenance. The rotor is keyed to the shaft and its outer surface is turned to insure smoothness and an accurate air gap. Other features are oil drains at the bottom of the bearings to faacilitate flushing, removable end pieces, and large conduit box for easy wiring. 75

GE Air Circuit-Breakers for Welding Machines

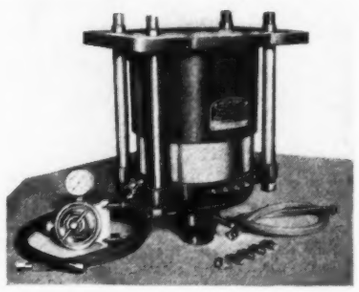
Air circuit-breakers which can be incorporated as an integral part of resistance welding machines by manufacturers of the machines are now being made by the General Electric Co., Schenectady, N. Y. In most cases heretofore, welding machines have been sold without a protective device, and the purchaser had to add one to the equipment. The present trend is toward the incorporation of the protective, control, and timing devices in the welding machine.

These circuit-breakers have a wide range of calibration, offering a choice of trip settings which will provide full protection and still allow maximum output of the tube. They can be arranged to open the circuit in case of "low voltage" or no "water flow," and also to close the circuit by a remote push-button control. 76

Gatco Horizontal Carbide and Diamond Borer

Horizontal carbide and diamond boring machines are now being manufactured by the Giern & Anholtt Tool Co., Inc., 1312 Mt. Elliott Ave., Detroit, Mich., in addition to its line of vertical machines. A 2D horizontal machine is shown in the illustration equipped with a fixture designed to employ Gatco rotating pilot bushings as supports for the boring-bars.

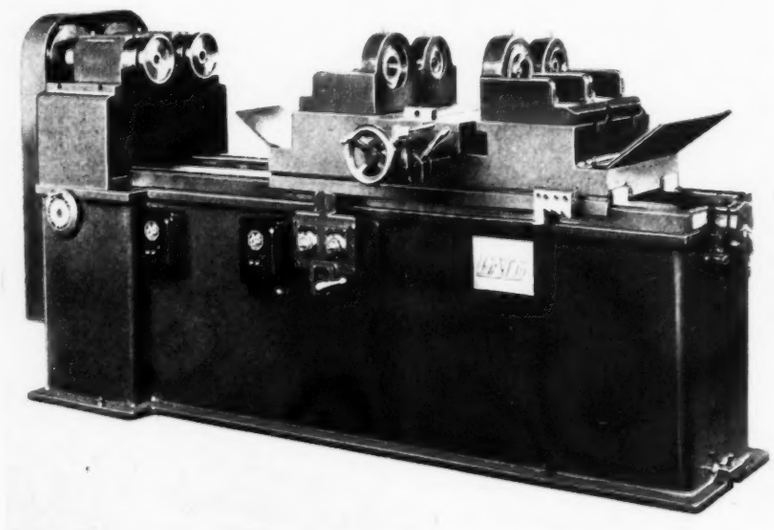
This machine is driven by V-belts and a speed selector directly connected with the motor. The table travel is 40 inches, and the spindle center is 9 inches above the table. The machine requires a floor space of 40 by 106 inches, and weighs 6000 pounds. 77



Dayton Universal Pneumatic Die Cushion

Dayton Pneumatic Die Cushion

The Dayton Rogers Mfg. Co., 2830 Thirteenth Ave., S., Minneapolis, Minn., has just placed on the market a Model DB universal pneumatic die cushion that is adaptable to a large percentage of press operations requiring cushioning for drawing and forming work. This is a self-contained unit which automatically maintains a predetermined cushioning pressure on either the draw-ring or pressure-pad. The pressure-pad control utilizes a combination regulator and gage, and is designed to enable the operator to make the fullest use of his skill in the production of drawn and formed parts. A record of the pressure employed is obtained by means of the pressure gage, so that on repeat set-ups the same working pressure can be quickly duplicated to insure uniformity of the product.



Gatco Carbide and Diamond Borer Brought out by Giern & Anholtt Tool Co., Inc.

To obtain additional information on equipment described on this page, see lower part of page 160.

ZINC IN WAR

5 CERAMICS

"AN ARMY MARCHES ON ITS STOMACH"

U. S. ARMY SIGNAL CORPS PHOTO

The United States armed forces are not only well fed, but a high degree of cleanliness is maintained in the preparation and serving of the food. White is the symbol of purity, and zinc pigments not only make *paint* whiter and more durable, they also serve in this capacity in *tiling*, *porcelain enamelware* and *dishes* in Army and Navy kitchens and mess halls.

Zinc oxide is used as a flux in ceramics to provide whiteness and gloss and to resist the shock of sudden temperature changes. Its presence prevents crazing of pottery and chipping of porcelain enamel. In ceramic manufacturing, zinc oxide provides such indispensable formulation features as fusibility, non-volatilization and wide temperature range.

When one considers the number of American soldiers, sailors and marines to be fed "three squares a day" — plus the fact that imports of European ceramic products have been cut off almost completely — the demands for zinc oxide by our ceramic industry can be appreciated.

This is just another one of the normal uses for zinc which has become greatly expanded by war needs — one more reason why civilian users may not be able to obtain all of the zinc they would like to use.

DIE CASTING

METAL SPRAYING

GALVANIZING

PHARMACEUTICALS

NICKEL SILVER

1 HULL PLATES

2 RUBBER

3 PAINT

4 BRASS

THE NEW JERSEY ZINC COMPANY

MANUFACTURERS OF THE FAMOUS HORSE HEAD ZINC PRODUCTS

New Jersey Zinc

Each cushion can be supplied with a special pin pressure-pad to make use of the entire pin area available in connection with the maximum press bed opening. The pneumatic die cushion can be mounted on the bolster plate by simply drilling and tapping four stud holes. Lubrication of the cushion units is accomplished from the front of the cushion cylinder. These cushions are now made in sizes of from 6 to 20 inches, having a maximum drawing capacity of 10 inches and ring holding pressures up to 15 tons. No surge tanks are necessary for standard drawing operations when this equipment is used. 78

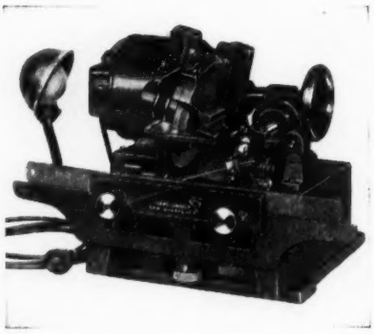
Airless Rotoblast Cabinet for Cleaning Oxygen Cylinders

In response to the demand for equipment capable of cleaning unprecedented quantities of steel oxygen cylinders, the Pangborn Corporation, Hagerstown, Md., recently developed the airless Rotoblast cabinet shown in the accompanying illustration. This equipment has an entirely automatic system of conveying the work through the blast stream.

The Harrisburg Steel Corporation, now using this equipment, is turning out 450 large cylinders per hour, which is three times the highest production rate previously attained. 79

Howe-Lindsey Automatic Saw-Sharpening Machine

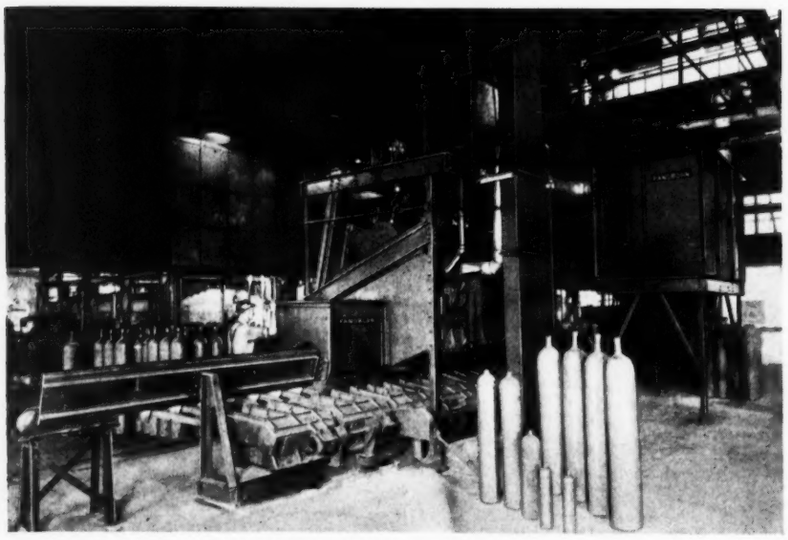
Howe & Son, Inc., Hinsdale, N. H., have just brought out an automatic machine for sharpening and reconditioning hacksaw blades, band-saw blades, circular saws, metal slitting saws, etc. This high-speed, fully automatic machine is known as the "Howe-Lindsey" saw sharpener. It is designed to handle all saw-sharpening operations at minimum cost, and is intended for



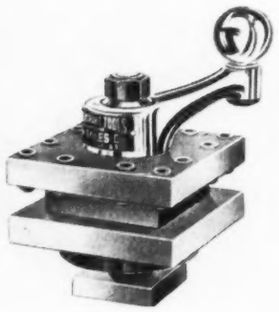
Howe-Lindsey Saw-sharpening Machine

use in large plants, as well as in small job and repair shops using metal-cutting saws.

Hacksaws of any length, width, or pitch and band saws of any size can be sharpened on this machine. The circular saw attachment is furnished as extra equipment, and is not ordinarily included with the machine. 80



Airless Rotoblast Cabinet for Cleaning Oxygen Cylinders, Built by the Pangborn Corporation



"Mastercraft" Toolpost Made by F. & M. Sales Co.

Improved "Mastercraft" Turret Toolpost

The "Mastercraft" turret toolpost manufactured by the F. & M. Sales Co., Hollywood, Calif., has been completely redesigned to include many new features, such as lighter weight and streamlining, with a view to obtaining faster action. Precision manufacturing methods are employed, so that all parts are interchangeable, thus permitting the user to set aside a tool-block with all tools in place for future use while another tool-block is mounted on the same post. Complicated tool set-ups can thus be retained for subsequent runs at a saving in set-up time.

This new four-way indexing turret toolpost has been designed especially for use on 10-inch South Bend and 9-inch Workshop and similar lathes, as well as for use on small screw machines. Socket screws have been substituted in place of standard set-screws. Four steel balls are employed in the block to insure accurate indexing in all four positions. 81

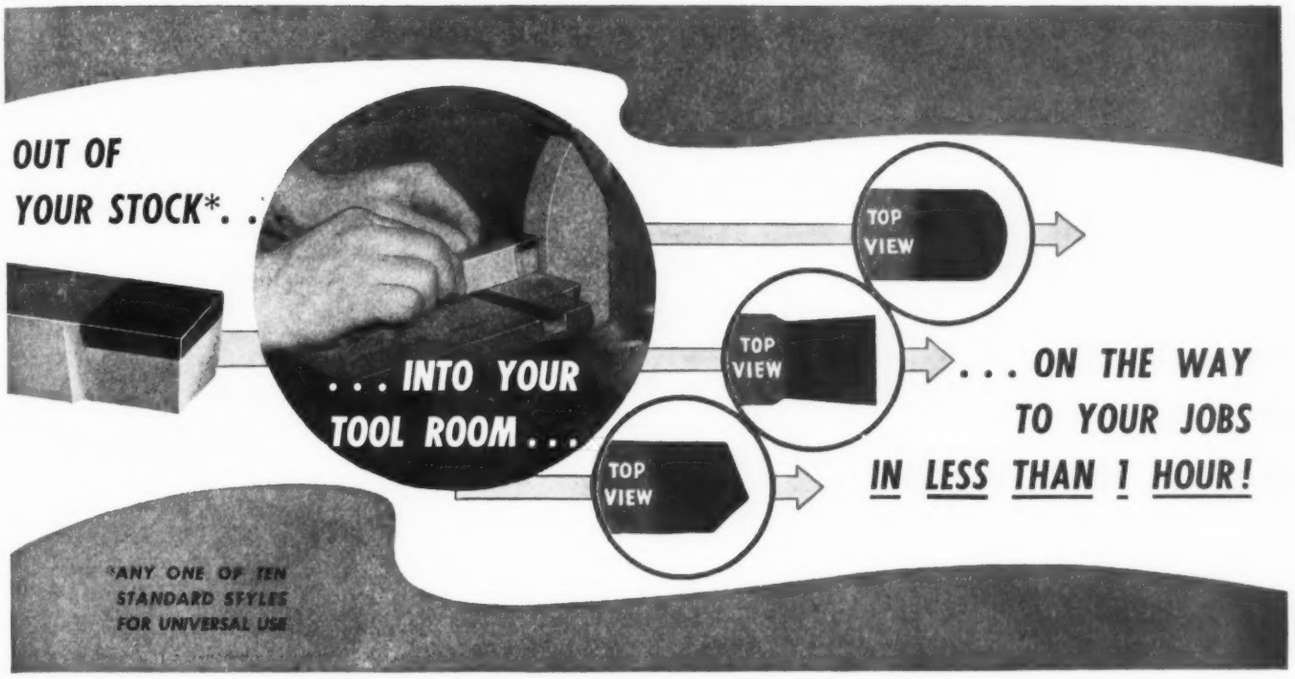
Elapsed Time Meter for Industrial Use

To check machine tool production and tool life in industrial plants where time studies are made, the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has brought out a new meter that indicates elapsed time in minutes or hours. The device has six counter units, and consists essentially of a synchronous driving motor, a gear train, and six numbered wheels.

The motor operates at 600 R.P.M. on a 115-volt, 60-cycle circuit. Synchronous operation is not af-

To obtain additional information on equipment described on this page, see lower part of page 160.

How To Get "Special" Carboloy Tools On Your Job *In Less Than One Hour!*


OUT OF YOUR STOCK*. . .
. . . INTO YOUR TOOL ROOM . . .
TOP VIEW
TOP VIEW
TOP VIEW
. . . ON THE WAY TO YOUR JOBS IN LESS THAN 1 HOUR!
*ANY ONE OF TEN STANDARD STYLES FOR UNIVERSAL USE

Busy production executives who want to establish a way to get specially shaped carbide tools on machining jobs *FAST*, can save time and money and get immediate results by following this simple, practical plan:

1. Have your tool designers select Carboloy Standard Tool styles suitable for quick adaptation to your special shapes.
2. Establish, in your tool crib, a nominal stock of the standards your designers select.
3. Grind these standards to special shapes *as required.*

This standardization plan is being followed today by many leading producers of tanks, engines, shell, guns, small arms and other war materials. It permits maximum tool economy, eliminates delivery delays and provides a way to get special tools on the job *FAST!*

Send for catalog GT-140.

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CARBOLOY STANDARD-STOCK TOOLS

Adaptable to 80% of all turning, boring and facing applications.

Send for free catalog →

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CEMENTED CARBIDES

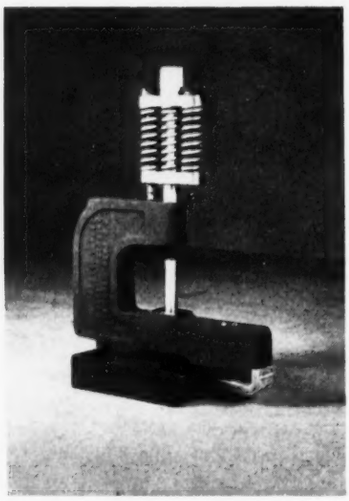
TOOLS • DIES • DRESSERS
CORE BITS • MASONRY DRILLS
• WEAR RESISTANT PARTS •

FOR THE MANUFACTURING • MINING • TRANSPORTATION • CONSTRUCTION INDUSTRIES

fected by voltage variations of from 75 to 125 per cent of the rated value. To operate, the meter is connected in parallel with the apparatus of which total hours of operation are to be measured. 82

Wales Narrow Type Punch- and Die-Holder

Punch- and die-holders of compact, narrow design, known as "Naropunch," have recently been added to the Wales line made by the Strippit Corporation, 1200 Niagara St., Buffalo, N. Y. These punch- and die-holders will punch holes up to 3/16 inch in diameter with a minimum center-to-center distance of 5/8 inch. The shut height is 6 1/4 inches.

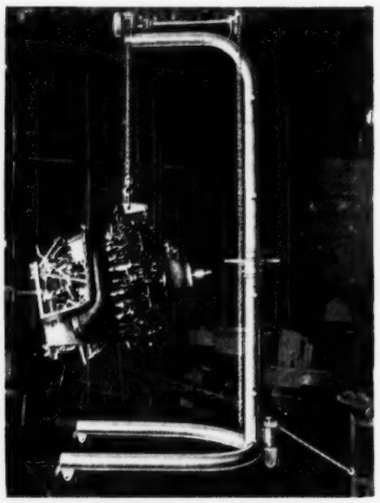


Strippit "Naropunch" Punch- and Die-holder

The selective stripping feature employed in Wales punch- and die-holders previously described in MACHINERY is also used in the new holder. This feature provides three instantly removable and interchangeable springs for adjusting the stripper spring tension to suit the requirements of various gages and kinds of metal. 83

Whiting "Aero" Hoist

A portable hoist of simplified design is being placed on the market in 1- and 2-ton models by the Aviation Department, Whiting Corporation, Harvey, Ill. Originally designed especially for the aviation industry, this "Aero" hoist is also being used to advantage in general manufacturing operations. All unnecessary superstructure has been eliminated to facilitate handling the work.

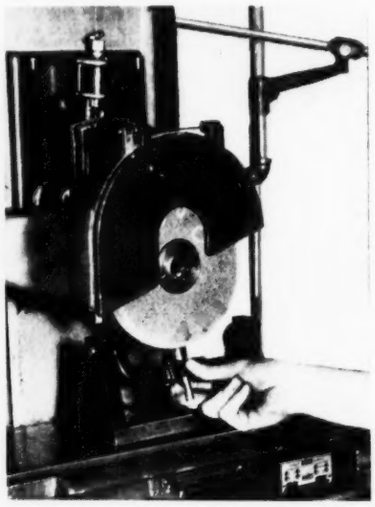


"Aero" Hoist Brought out by Whiting Corporation

The hoist has a single upright mast equipped with riser steps and an adjustable platform. A chain hoist raises and lowers the work, and supports it at any desired height. An extension keeps the hand-chain away from the load, and a brake locks the hoist. 84

"Little Wonder" Radius Dresser

One of the latest products in the line of machine tool accessories to be placed on the market by the George Scherr Co., 128 Lafayette St., New York City, is the "Little Wonder" radius dresser designed to speed up and simplify the dressing of abrasive wheels for various types of grinding operations. The device is used in conjunction with a diamond tool to dress wheels preparatory to grinding forming tools, fillets, end-mills, and for grinding rake angles on collapsible tap chasers. It could be used for dressing convex or concave radii up to 1 inch, and can be set with a regular 1-inch micrometer, depth micrometer, or height gage. 85



"Little Wonder" Radius Dresser

Ajax Electric Heating Unit for Brazing

High-Frequency Heating Unit for Brazing Operations

A six-kilowatt, high-frequency, self-contained brazing unit having a capacity for performing seventy-five brazing operations per hour has been brought out by the Ajax Electrothermic Corporation, Trenton, N. J. After the surfaces to be brazed have been properly prepared, a ring of compound is placed in position and the assembly heated by placing it inside the induction ring of the heating unit, thus brazing the parts without producing any residue that must be cleaned off after the operation. To obtain higher production rates, small high-frequency generators can be used. For example, a 50-kilowatt high-frequency generator, inductors, and controls will braze 1200 pieces per hour.

This high-frequency equipment can be converted at any time for

To obtain additional information on equipment described on this page, see lower part of page 160.

MODERN MIDLAND DESIGN

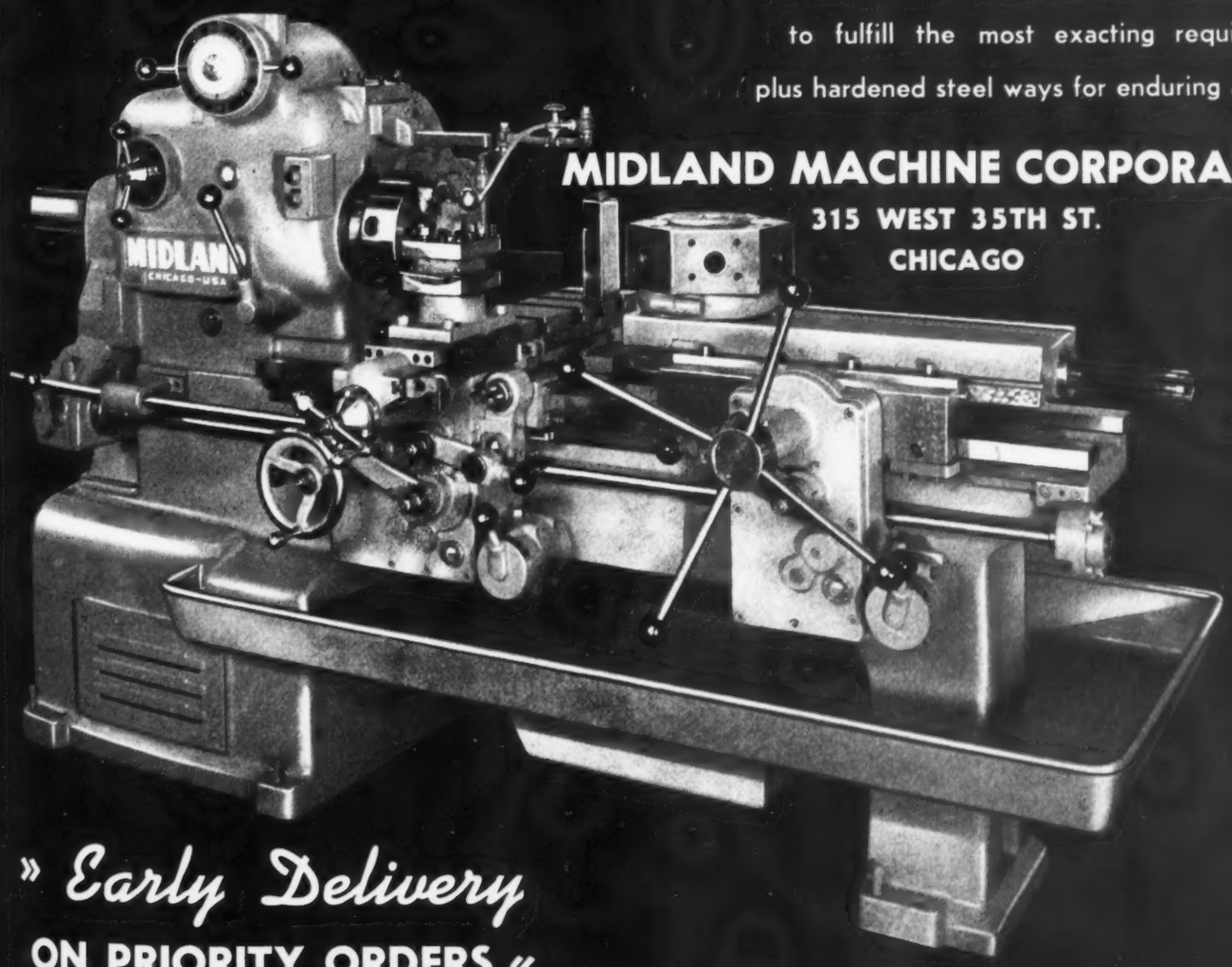
IN AIRCRAFT PRODUCTION

Modern Design is the factor today, the means with which Victory will be ours. In munitions production — aircraft production — the modern design of MIDLAND Turret Lathes provides the utmost in production abilities. For MIDLAND Turret Lathes are "modern-designed" by a staff of experienced production and manufacturing engineers . . . built to fulfill unusually rigid specifications for ruggedness and sustained accuracy in any 3-shift-per-day heavy-duty production schedule. The result is a powerful, accurate, convenient Turret Lathe to speedily and powerfully deliver high rate of production with characteristically close tolerances. You can depend upon MIDLAND . . .

and convenience of operation for maximum output.

to fulfill the most exacting requirements.

plus hardened steel ways for enduring accuracy.



MIDLAND MACHINE CORPORATION
315 WEST 35TH ST.
CHICAGO

» *Early Delivery*
ON PRIORITY ORDERS «

other forms of brazing, melting alloys, sintering carbide tools, or for experimental heats. 86

Ohmite Rheostat Cages

A variety of cages designed to enclose and protect Ohmite rheostats from mechanical injury, as

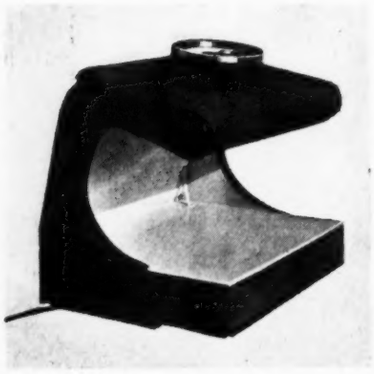
Ohmite Rheostat with Protecting Cage

well as prevent human contact with electrically "live" parts, has been developed by the Ohmite Mfg. Co., 4835 Flournoy St., Chicago, Ill. These cages are available in surface mounting types for fractional-horsepower motor controls and for heating device controls. 87

Frantz Magnetic Separator of Increased Capacity

The S. G. Frantz Co., Inc., 223 Centre St., New York City, has added to its line of magnetic separators a recently developed permanent magnet "FerroFilter" of greater capacity than any filter of this type previously available. The new filter, designated the "PQ-6," has a capacity of 200 gallons per minute, 3-inch pipe size connection, and a height of 15 5/8 inches.

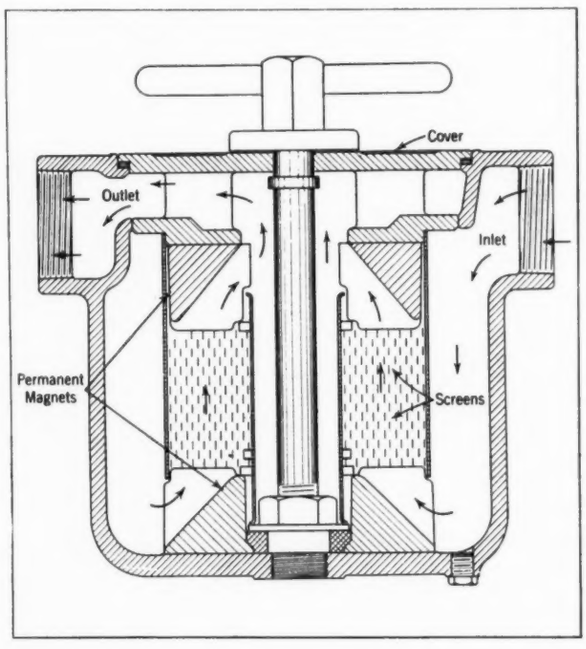
This filter has no moving parts, and is especially adapted for the removal of harmful fine iron and steel particles from circulating coolant systems of machines used in tapping, grinding, deep-hole drilling, reaming, rifling, etc. It is also adapted for lubricating systems of pumps, Diesel engines, roll grinders, etc. 88



Inspectograph Placed on the Market by Schultz & Anderson Co.

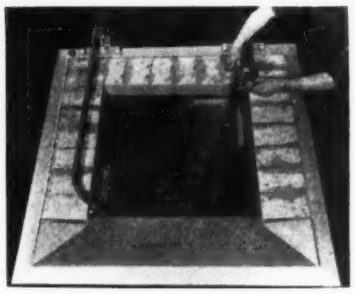
Inspectograph Designed for Inspection of Finished Parts

An instrument consisting essentially of a magnifying lens 4 inches in diameter, fluorescent lighting tubes with transformers, starter, 6-foot cord and switch, is being placed on the market by the Schultz & Anderson Co., 174 Ferry St., Newark, N. J., for use in the inspection of finished parts. This instrument, designated the "Inspectograph," is 11 1/2 inches wide, 12 inches high, and 10 inches deep. The soft diffused fluorescent light is so enclosed that it is concentrated entirely upon the object. The large lens is employed to speed up inspection operations and reduce unnecessary strain on the eyes.



Cross-section of Frantz Magnetic Separator

This device is adaptable to a wide range of applications. In machine shops and tool-rooms, it is used extensively for finding cracks, scratches, and tool marks on dies; working on small punches; inspecting bearing surfaces; sharpening tool bits, drills, reamers, and milling cutters; accurate micrometer reading; laying out fine work; and inspecting screw machine products, gun parts, gages, taps, castings, and work of a similar nature. 89

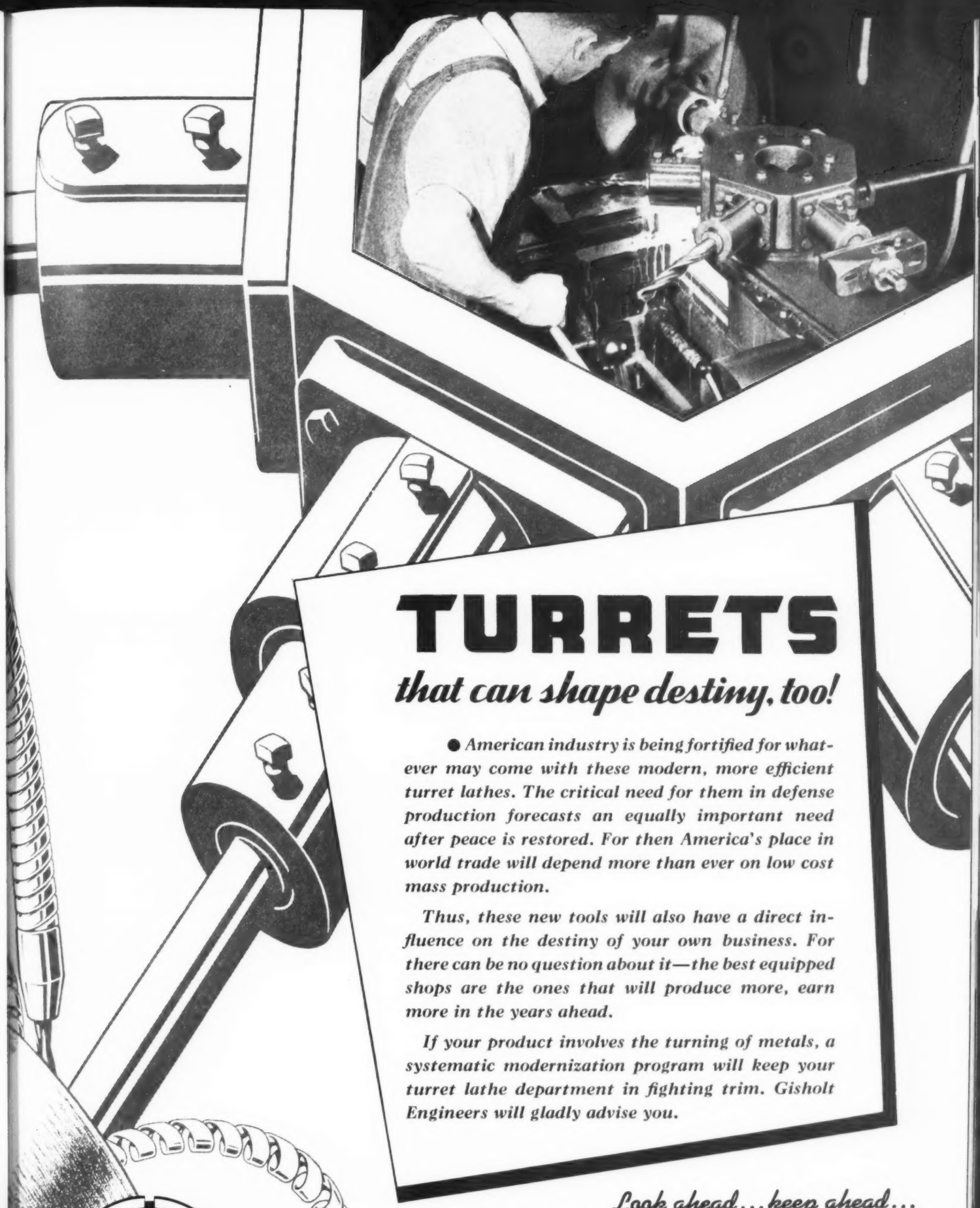


Upton Improved Salt Bath Pot Construction

Improved Salt Bath Pot Construction

An improved design of insulating pot for electric salt bath furnaces which requires fewer bricks, reduces maintenance cost, and increases working space has recently been developed by the Upton Electric Furnace Division, 7450 Melville at Green, Detroit, Mich. The new construction is designed for low temperatures, and for such work does not require brick insulating, except at the corners, where the electrodes are located. Thus, instead of having to line the entire surface of the floor and walls of the pot with bricks, only the floor and the space immediately behind the electrodes require the insulating material. When the bricks are to be renewed, it is only necessary to slide them out at the top of the retaining frame and replace them with new bricks, thereby saving material that would otherwise be required to reline the entire surface of the four walls. 90

To obtain additional information on equipment described on this page, see lower part of page 160.



TURRETS

that can shape destiny, too!

● *American industry is being fortified for whatever may come with these modern, more efficient turret lathes. The critical need for them in defense production forecasts an equally important need after peace is restored. For then America's place in world trade will depend more than ever on low cost mass production.*

Thus, these new tools will also have a direct influence on the destiny of your own business. For there can be no question about it—the best equipped shops are the ones that will produce more, earn more in the years ahead.

If your product involves the turning of metals, a systematic modernization program will keep your turret lathe department in fighting trim. Gisholt Engineers will gladly advise you.

Look ahead... keep ahead...
with Gisholt improvements in metal turning

GISHOLT MACHINE COMPANY

1209 EAST WASHINGTON AVENUE • MADISON, WISCONSIN

TURRET LATHES · AUTOMATIC LATHES · BALANCING MACHINES

Information for Firms Looking for War Contracts

For those firms who are eager to convert their plants to war work, the War Production Board, Production Division, Contract Distribution Branch, Washington, D. C., issues a weekly publication called *W. P. B. Contract News*. In this publication, it is mentioned that the Contract Distribution Branch is organized to "spread the work"—to get war production contracts distributed to more manufacturers, to more plants. It fosters sub-contracting and helps manufacturers to fit themselves into the war program. It is intended to help them with engineering, technical, financial, and special information, advice, and assistance.

The district offices of the Contract Distribution Branch have displays of parts for the production of which contractors and sub-contractors are wanted. They have available blueprints, copies of Army and Navy invitations to bid, lists of proposed purchases, and similar information.

The Contract Distribution Branch of the War Production Board addresses the following to manufacturers who may wish to obtain war work for their plants:

"Apply to the nearest office of the War Production Board, Contract Distribution Branch." A list of the offices can be obtained by application to the Contract Distribution Branch, Social Security Bldg., Washington, D. C. Those having exhibits of parts to be made are given at the end of this article.

"If you have not submitted a list of your production facilities, ask for the special Government form provided for that purpose, and fill out and return that form as soon as possible.

"If you want information, advice, or engineering assistance, write to the nearest War Production Board office or call there in person and consult with one of the engineers.

"If you have too much war work—more than you can keep up to schedule in your own plant—and want assistance in sub-contracting portions of it to other manufacturers, there is information available for that purpose."

Fourteen permanent sub-contracting exhibits are now in operation in industrial centers of the nation. The purpose of these exhibits is to show small manufacturers how they can turn their facilities to war production. It is also intended to aid prime contractors and Government procurement agencies in finding additional manufacturing facilities for war materials.

These sub-contracting exhibits are located in the following cities: Atlanta, Ga. (Fifth Floor, Mutual State Bldg.); Boston, Mass. (First National Bank, 17 Court St.); Buffalo, N. Y. (Fourth Floor, White Bldg.); Chicago, Ill. (Civic Opera Bldg.); Cleveland, Ohio (Union Commerce Bldg.); Detroit, Mich. (Boulevard Bldg., 7310 Woodward Ave.); Los Angeles, Calif. (Western Pacific Bldg.); Memphis, Tenn. (Eighteenth Floor, Sterick Bldg.); Newark, N. J. (Globe Indemnity Bldg., 20 Washington Place); New Orleans, La. (Seventh Floor, Canal Bldg.); New York, N. Y. (Chanin Bldg., 122 E. 42nd St.); Philadelphia, Pa. (Broad St. Station Bldg.); San Francisco, Calif. (Whitcomb Hotel); St. Louis, Mo. (Boatmen's Bank Bldg., 420 Locust St.).

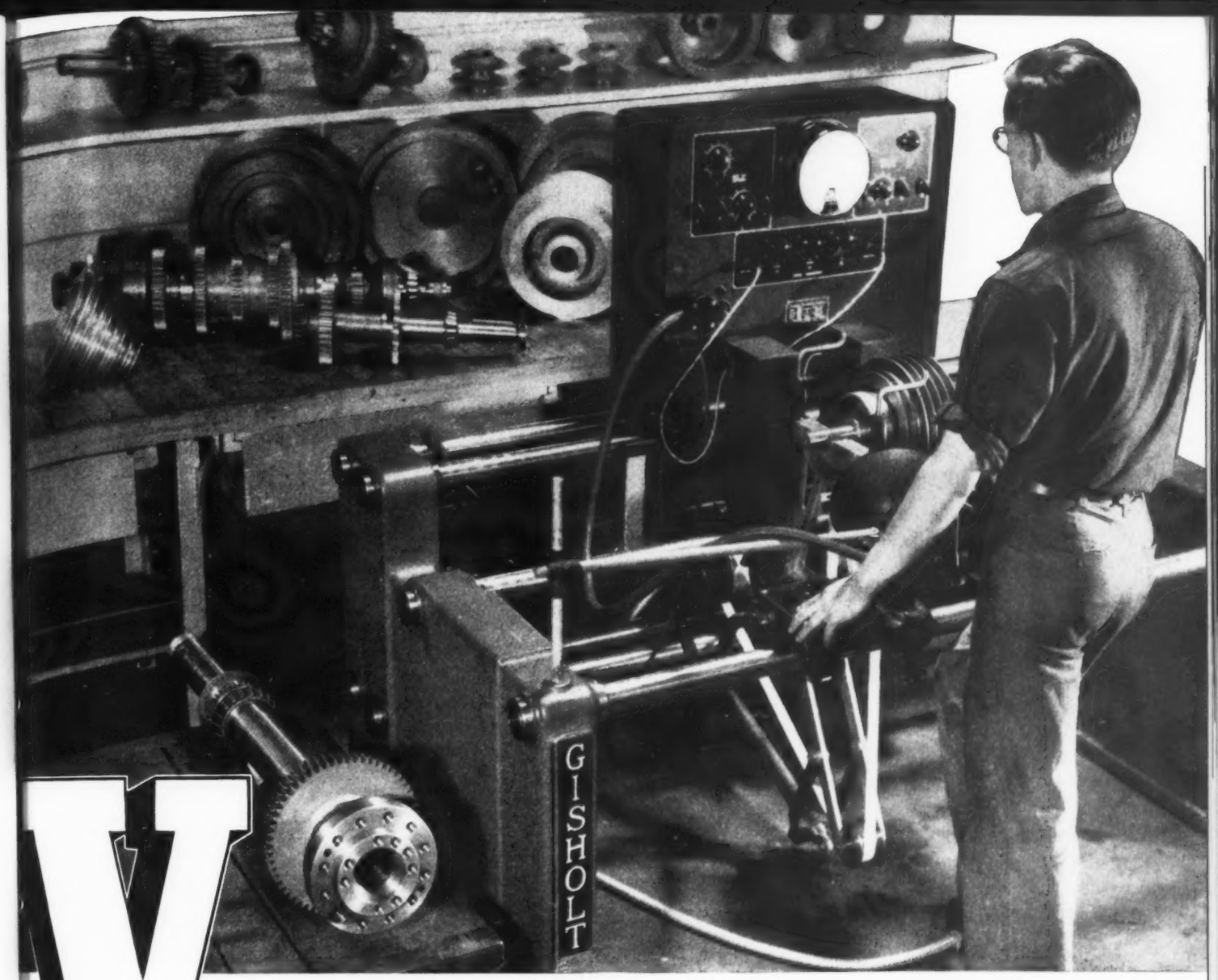
Addition to Landis Machine Co.'s Plant

The Landis Machine Co., Waynesboro, Pa., has completed an addition to its plant in order to increase its manufacturing capacity. The new addition which affords approximately 25,000 square feet of floor area, includes a structure 60 by 350 feet which will house a new erecting floor and shipping department, and a wing, 50 by 80 feet, which will be used for the box and crate manufacturing department and lumber storage. A second building, 30 by 60 feet, provides storage for chips. This building is divided into three compartments, where chips are stored according to their analysis. It is located on a railroad siding, so that the chips can be moved directly from the storage building onto railroad cars.

The main structure, which houses the assembly and erecting department, is built from brick, concrete, and steel. It is 36 feet in height and serviced by a 10-ton crane.

The new assembly and erecting department, in addition to being employed for the company's regular line of thread-cutting machinery and equipment, provides a modern plant for building the new precision thread grinder which was recently announced by the company.

Addition to the Plant of the Landis Machine Co., Waynesboro, Pa., which Affords 25,000 Square Feet of Floor Area. The Main Structure Houses the Erecting Floor and Shipping Department



Versatile

FOR BALANCING MANY DIFFERENT PARTS!

Yes, any of these different sizes and types of parts are now statically and dynamically balanced—in a few moments—on this *one machine!*

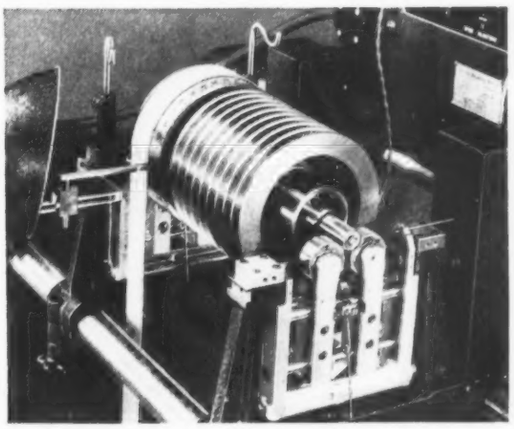
This development enables you to make important product improvements—to eliminate noisy and destructive vibration—to assure quieter operation and longer life of rotating parts.

DYNETRIC BALANCING MACHINES

By detecting and amplifying unbalance vibrations, Gisholt Dynetric Balancing Machines enable you to locate, measure and correct unbalance in a way that is quick, easy and accurate. Speed in handling such a variety of parts makes proper balancing more economical than ever before.

If your product will benefit through the accurate balancing of rotating parts, write for literature.

GISHOLT MACHINE COMPANY
1209 E. Washington Ave., Madison, Wisconsin



★ Balancing a Vee-belt sheave for a machine tool. Note the roller-type work-supports which are adjustable to accommodate a variety of shaft sizes, permitting the balancing of other rotating parts with only one set of work supports.

Look ahead... keep ahead... with Gisholt improvements

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES

NEWS OF THE INDUSTRY

California

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., has made a license agreement authorizing the JOSHUA HENDY IRON WORKS, Sunnyvale, Calif., to use its designs and processes to produce marine turbines, gears, and auxiliary apparatus, in order to speed up production for the Navy and the U. S. Maritime Commission.

I. M. LADDON has been made executive vice-president and general manager of the Consolidated Aircraft Corporation, San Diego, Calif. He was previously vice-president and works manager.

District of Columbia

AMERICAN SOCIETY OF TOOL ENGINEERS has chartered a new chapter at Washington, D. C., known as the Potomac Chapter, which is the forty-eighth local chapter of the Society. RAYMOND C. HARBST, chief tool and gage designer of the U. S. Naval Gun Factory, was elected chairman.

Illinois

HARMON S. EBERHARD has been made vice-president of the Caterpillar Tractor Co., Peoria, Ill., in place of the late Thomas J. Connor. In order to take care of other duties handled by Mr. Connor, a new research department has been established, headed by C. G. A. ROSEN. G. E. BURKS has been promoted to the position of chief engineer, J. R. MUNRO to general factory manager, and CHARLES A. WOODLEY to factory manager of the Tractor Division.

W. A. JONES FOUNDRY & MACHINE CO., Chicago, Ill., recently held a two-day conference at which sales and production problems brought about by the tremendous war requirements for transmission products were studied. The conference was held at the Palmer House in Chicago, and was attended by the national sales force and factory executives of the company.

ARTHUR T. COX, JR., has been elected vice-president of the Lincoln Electric Railway Sales Co., with headquarters at Chicago, Ill. Mr. Cox was formerly a district sales manager in the Industrial Sales Division of the Lincoln Electric Co.

HAROLD W. MUNDAY, 332 S. Michigan Ave., Chicago, Ill., has been appointed district engineer in the Chicago territory for the Despatch Oven Co., Minneapolis, Minn.

FREDERICK POST CO., Hamlin and Avondale Aves., Chicago, Ill., manufacturer of blueprint papers and other drafting and engineering materials, has recently opened a new factory branch at 1215 Capitol, Houston, Tex.

COPPERWELD STEEL CO., Warren, Ohio, announces that the Chicago district office has been moved to 122 S. Michigan Ave. R. S. CLINGAR is Chicago district manager, in charge of the sale of Aristoloy alloy steels.

Michigan

WELTRONIC CORPORATION, E. Outer Drive, Detroit, Mich., announces that it has acquired all patent, manufacturing, and sales rights to the new type of refrigerating units for welding machines originally developed by the Progressive Welder Co. The units will be manufactured under the new trade name of "Frostrode." WALTER MOEHLENPAH will be manager of the Frostrode Division.

JAMES R. LONGWELL, formerly chief engineer of the Carboloy Company, INC., Detroit, Mich., has been appointed to the newly created post of factory manager. PAUL H. MILLER, who has been associated with the engineering department of the company for the last eight years, succeeds Mr. Longwell as chief engineer.

James R. Longwell, Newly Appointed Factory Manager of the Carboloy Company

Paul H. Miller, Chief Engineer, Carboloy Company

GEORGE EGLINTON, sales manager of the Wickman Corporation, Detroit, Mich., has resigned and will return to his former position as vice-president and general manager of the Lincoln Park Tool & Gage Co., Lincoln Park, Mich. Mr. Eglinton's decision to make this change came as the result of the greatly increased demands put on the Lincoln Park organization by the new war program. The new sales manager will be T. B. CARPENTER, for the last seven years associated with the National Automatic Tool Co., Richmond, Ind. Mr. Carpenter was one of the founders of the American Society of Tool Engineers, and served on the original board of directors. He was president for the year 1933-1934.

J. D. MCKNIGHT has been made assistant district manager of the Detroit office of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. Mr. McKnight has been a member of the Detroit sales staff for six years.

W. F. NEWBERY has been promoted to the position of central region manager of the Detroit Rex Products Co., Detroit, Mich., manufacturer of metal-cleaning equipment and materials.

STELLAR TOOL & GAUGE is a new concern, organized by Frank W. Biringer to manufacture gages. The company is located at 1906 Highland Ave., Detroit, Mich.

Want Rated Capacity Plus?

SUNOCO EMULSIFYING CUTTING OIL

*permits faster speeds..greater feeds..higher P-Q**

For the greatest production job in history, American machine tools must produce—not at rated capacity—but at rated capacity-plus . . . from rough cut to finish grind!

Take a tip from the leading machine tool builders who choose, use and recommend SUNOCO EMULSIFYING CUTTING OIL to keep their machine tools operating at rated capacity-plus. Flood your tools and work with SUNOCO!

SUNOCO's high lubricating and heat absorbing qualities protect tools from seizing, burning and chipping . . . SUNOCO makes possible increased speeds and feeds . . . longer tool life . . . less "down time" . . . finer finish . . . fewer rejects . . . higher P-Q (Production Quota).

Don't delay. Call in a SUN "Doctor of Industry"—a metal working expert—today. Get his recommendations on the proper cutting lubricants to help make your machine tools operate at rated capacity-plus . . . to help you set and maintain a higher P-Q.* Write

SUN OIL COMPANY • PHILADELPHIA

*Production Quota

SUNOCO

PERFORMANCE DATA

OPERATION—Turn O.D. and face sides of gears—S.A.E. 4615.

MACHINE—Sundstrand Automatic Lathe.

CUTTING LUBRICANT—1 part Sunoco to 20 parts water.

Courtesy of Sundstrand Machine Tool Co.

SUN PETROLEUM PRODUCTS HELPING INDUSTRY HELP AMERICA

New England

McKENNA METALS CO., Latrobe, Pa., has appointed, as sales representatives in the eastern district, R. S. HUDGINS, 965 Farmington Ave., West Hartford, Conn., and CHARLES E. WASHBURN, 258 Park Square Bldg., Boston, Mass.

AMPCO METAL, INC., 1745 S. 38th St., Milwaukee, Wis., has appointed J. P. HENRY as New England representative of the company, with headquarters at the Capitol National Bank Building, 410 Asylum St., Hartford, Conn.

New Jersey

FRANK E. SHURTS has been elected president of the American Swiss File & Tool Co., Elizabeth, N. J. R. D. MACDONALD becomes vice-president and treasurer, and PHILIP SCHAEFFER, secretary. Mr. Shurts has been connected with the company since 1919, and Mr. MacDonald since 1930. Since the death last October of Paul F. Reichhelm, former president of the company, Mr. Shurts and Mr. MacDonald have been in charge.

W. L. WHITE, director of laboratories of the Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J., and H. SNYDER, manager of the roll covering and tank lining departments, are now assistant factory managers. H. H. BURROWS will succeed Mr. Snyder, and P. A. CADY will serve as laboratory manager.

HARRY E. SMITH, general manager of the Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J., was recently elected a member of the board of directors of the Rubber Manufacturers Association, Inc., in place of F. L. CURTIS, former general manager of the Manhattan Rubber Mfg. Division.

R. H. CRAMER has been appointed factory manager of the Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., succeeding C. P. MILLARD, who has resigned. Mr. Cramer was formerly assistant factory manager.

New York

SIMMONS MACHINE TOOL CORPORATION, Albany, N. Y., has organized part of its business as a department to be known as the New Machine Tool Division. The firm has been known in the industry for the last thirty years, as a rebuilder of metal-working machinery. Recently, it has become a factor in the manufacture of new machine tools, including lathes, plain milling machines, and horizontal boring and facing machines. CHARLES A. SIMMONS, JR., executive vice-president and general manager of the firm, will direct the operations of the new division, with B. A. GETZ as his assistant in charge of sales. Mr. Getz had many years of machine tool building experience with the Sidney Machine Tool Co. prior to joining the Simmons organization more than four years ago. L. W. ROLFE, manager of the New York office, has been transferred to the plant at Albany, where he will assist in the operation of the rebuilding division.

FLUORESCENT LIGHTING ASSOCIATION, with headquarters at 509 Fifth Ave., New York City, has been organized by the leading manufacturers of fluorescent tubing primarily as a wartime measure to provide maximum illumination from a minimum of materials. The Association will soon have exhibition installations available in metropolitan centers to demonstrate the advantages of cold-cathode continuous-tube fluorescent illumination.

A. H. BOND has been appointed coordinator of the war industries work of Oakite Products, Inc., 22 Thames St., New York City. Mr. Bond will furnish information to government officials and manufacturing executives on the latest developments in production cleaning and related manufacturing operations essential to producing artillery, tanks, airplanes, rifles, shells, cartridge cases, helmets, etc.

F. G. FLOCKE, welding engineer in the Development and Research Division of the International Nickel Co., Inc., 67 Wall St., New York City, addressed the Metropolitan New York Section of the American Welding Society on February 11, and the Columbus, Ohio, Division of the Society on February 13. The subject of his talks was "The Properties and Fabrication of Monel, Nickel, and Inconel."

ANTON SMIT & CO., INC., importers of industrial diamonds and manufacturers of diamond tools, announce their removal from 24 State St., New York City to new quarters at 333 W. 52nd St. The company's subsidiary, the DIAMOND CORE BIT & TOOL CO., formerly at 108 Water St., New York City, is also moving to the new location.

ROBERT H. LEDING, regional business consultant of the United States Department of Commerce, has resigned and joined the staff of Sheldon R. Coons, 113 W. 57th St., New York City, business counsel in management, merchandising, and advertising.

LURIA STEEL & TRADING CORPORATION, 233 Broadway, New York City, has been appointed exclusive distributor for FORGED CARBIDES, INC., manufacturer of a new type of cutting tool having forged tungsten-carbide tips.

GEORGE J. KELLER, for the last six and one-half years with the R. L. Crane Machinery Co., resigned January 1 to start the GEORGE KELLER MACHINERY CO., which is located at 1807 Elmwood Ave., Buffalo, N. Y.

Ohio

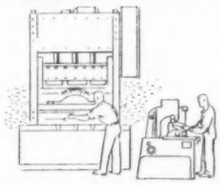
W. K. BAILEY has been elected vice-president in charge of sales of the Warner & Swasey Co., Cleveland, Ohio, and a member of the board of di-

Greystone Studios

W. K. Bailey, Vice-president in Charge of Sales of the Warner & Swasey Co.

D. M. Pattison, Recently Appointed Sales Manager of the Warner & Swasey Co.

Don't tie up an Extra Press use your Quickwork for TRIMMING STAMPINGS



Save valuable press time. Save time and cost of trimming dies. Use the Quickwork-Whiting Stamping Trimmer for trimming stampings in a single plane.

The Quickwork handles both large and relatively small stampings—with or without flash. The shearing action of the cutters provides clean, smooth work at speeds up to 16 ft. per minute.

The Quickwork-Whiting Stamping Trimmer is also used in forming, flanging, and beading operations. It is recommended for straight line production or job shop work.

Save TIME—get full information about the Quickwork-Whiting Trimmer.

Above: The accuracy and smoothness of the Quickwork-Whiting Stamping Trimmer are demonstrated by the results obtained on this unusually heavy stamping.

Special models of the Quickwork Stamping Trimmer are available, such as this flat table type, hand lever operated machine without overhead housing.

Use Quickwork-Whiting Machines to Speed Production

ROTARY SHEARS
—available in a complete range of sizes to cut, bevel, circle, flange, and joggle mild steel sheets up to 1".

POWER HAMMERS
—provide constant speed, unvarying rhythm. Force of blow controlled without slowing operation. Available in four sizes.

"QUICKWORK" WHITING

Division of Whiting Corporation, 15673 Lathrop Ave., Harvey, Illinois

rectors, filling the vacancy on the board caused by the death of Clifford S. Stilwell last November. Mr. Bailey's entire business career has been spent with the Warner & Swasey organization. He joined the company in September, 1919. He has served successively as service manager, assistant sales manager, and sales manager. D. M. PATTISON, assistant sales manager, will succeed Mr. Bailey as sales manager.

DOEHLER DIE-CASTING CO., Toledo, Ohio, has been awarded the Navy "E" pennant and the Bureau of Ordnance flag for outstanding contribution to the war effort. In addition, the 1500 employes of the company were presented with individual "E" bronze lapel buttons. The presentation was made by Captain A. E. Lofquist, chief of staff of the Ninth Naval District. Speakers at the presentation program, which was attended by the plant employes, were Governor John W. Bricker, Charles Pack, president of the Doehler Die-Casting Co., August G. Gutmueller, vice-president and Toledo plant manager, E. R. Zabriskie, vice-president and sales manager of the Doehler Die-Casting Co., Robert H. Kitzman, general superintendent of the Toledo plant, Edward T. Cheyfitz, secretary of the National Association of Die-Casting Workers, and Charles I. Gruber, president of Local 6, N.A.D.C.W.

ARO EQUIPMENT CORPORATION, Bryan, Ohio, has been awarded a class "A" rating for excellence of manufacture by the Materiel Division of the United States Army Air Corps. This corporation regularly manufactures automotive and industrial lubricating equipment and pneumatic tools. It was among the first automotive equipment manufacturers to become actively engaged in defense production, having developed a line of aircraft products and installed new machinery for its manufacture before the outbreak of war.

WARNER & SWASEY CO., Cleveland, Ohio, builder of turret lathes, has announced that the company is planning to expand its facilities so as to be able to increase its present production by 40 per cent. The expansion, consisting of two new buildings, will give the company 140,000 square feet of additional floor space.

F. F. SEAMAN, general manager of Robbins & Myers, Inc., Hoist and Crane Division, Springfield, Ohio, was re-elected chairman of the Electric Hoist Manufacturers Association at the annual meeting held in Washington, D. C., on January 14. The Association has headquarters at 165 Broadway, New York City.

GEORGE M. SNODGRASS has been appointed manager of the eastern sales division of the Sawyer Electrical Mfg. Co., Los Angeles, Calif. Mr. Snodgrass' headquarters will be at 2110 Terminal Tower, Cleveland, Ohio.

Pennsylvania

BIRDSBORO STEEL FOUNDRY & MACHINE CO., Birdsboro, Pa., is starting a building construction expansion program involving more than a million dollars. Contracts have been awarded for the erection of three new building units to the Turner Construction Co. of New York City. The new construction comprises a one-story addition, 303 by 86 feet, to the annealing building; a one-story pattern storage building, 274 by 60 feet; and a three-story office building, 50 by 146 feet.

ALLEGHENY LUDLUM STEEL CORPORATION, Pittsburgh, Pa., announces the creation of a new scrap and salvage department which will be located at the company's Brackenridge, Pa., plant under the management of E. L. MCGRAW, formerly director of purchases. E. A. GRINE has been appointed assistant manager. L. H. BITTNER will succeed Mr. McGraw as director of purchases. He will be assisted by N. W. HAYSON, who has been appointed purchasing agent.

DR. RUSH A. LINCOLN, metallurgist with the Allegheny Ludlum Steel Corporation at Brackenridge, Pa., recently addressed the Buffalo chapter of the American Society for Metals on the subject "The Mechanical Properties of Austenitic Stainless Steel," with especial reference to new developments for the aircraft industry.

AMERICAN PULLEY CO., Philadelphia, Pa., was recently awarded the Navy "E" pennant and the Naval Ordnance flag. Nearly 1000 employes and guests of the company attended the ceremony. Rear Admiral W. C. Watts, U.S.N., retired, presented the award.

ALLEGHENY LUDLUM STEEL CORPORATION, Pittsburgh, Pa., states that the company increased its working force by about 2000 employes during the past year. More than 12,000 workers are now being employed.

Wisconsin

WALTER GEIST, vice-president of the Allis-Chalmers Co., Milwaukee, Wis., has been selected to head a new department that has been established to coordinate the company's sales policies. This department has become necessary because of the fact that the sales organization is now very complex, due to the company's war effort, which puts practically the entire productive capacity at the disposal of the Army, Navy, and Air Corps.

MARTIN ELIASON, of the Chicago branch of the Jessop Steel Co., Washington, Pa., has been appointed representative in the Milwaukee territory, with headquarters at 419 Colby Abbott Building. Mr. Eliason was formerly sales representative and general superintendent at the Chicago division of the York Safe & Lock Co.

ABER ENGINEERING WORKS, INC., announces the removal of its office and factory from Racine, Wis., to Waterford, Wis.

COMING EVENTS

MARCH 2-6—Spring meeting and Committee Conferences of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotel Cleveland, Cleveland, Ohio. C. L. Warwick, secretary-treasurer, 260 S. Broad St., Philadelphia.

MARCH 12-13—Aeronautic Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Hotel New Yorker, New York City. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

MARCH 17-19—Annual convention of the AMERICAN RAILWAY ENGINEERING ASSOCIATION at the Palmer House, Chicago, Ill.

MARCH 23-25—Spring meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Houston, Tex. Secretary, C. E. Davies, 29 W. 39th St., New York City.

MARCH 26-28—Annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS, in St. Louis, Mo. Clyde L. Hause, secretary, 2567 W. Grand Blvd., Detroit, Mich.

APRIL 9-10—Annual meeting of the MIDWEST POWER CONFERENCE at the Palmer House, Chicago, Ill. For further information, address Alexander Schreiber, Illinois Institute of Technology, Chicago, Ill.

APRIL 20-24—Forty-sixth annual convention of the AMERICAN FOUNDRYMEN'S ASSOCIATION, Cleveland, Ohio. For further information, address American Foundrymen's Association, 222 W. Adams St., Chicago, Ill.

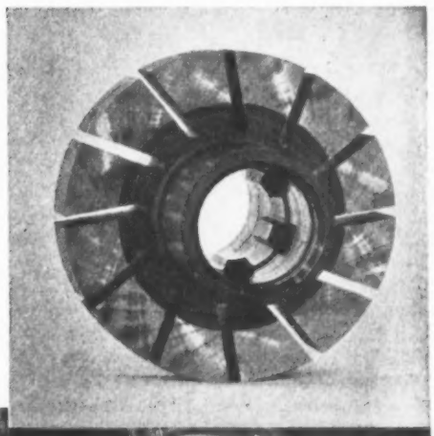
MAY 11-13 — Twenty-sixth annual convention of the AMERICAN GEAR

"TOOL ROOM" PRECISION *in* PRODUCTION *by* Broaching

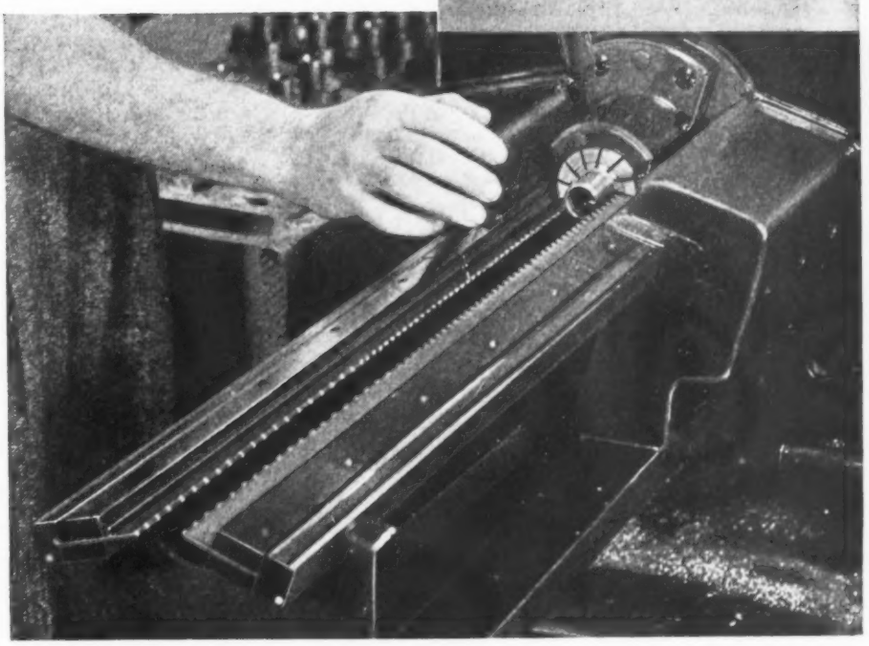
THE JOB: To put machining of pump rotor slots on production basis.

THE METHOD: Broaching two slots at a time in two passes.

THE RESULT: Lower cost per piece, fewer machines, tool room precision in production.



BROACHING PAYS IN JOB LOTS..No. 5



FACED with the problem of stepping up rotor production for precision hydraulic pumps from a-few-at-a-time to a capacity of several thousand per month, broaching was found to provide the answer to low-cost production accuracy.

On a job-lot basis, these slots —only about 5/64 inch across —are held to plus or minus two and one half ten thousandths with greater ease and uniformity by broaching than it was possible to hold the same parts, a few pieces at a time, by milling.

Even if the job could be done as well, it would have taken quite a few milling and drilling machines to do the same job as the single two-broach equipped Colonial. More details on this operation are to be found in the current issue of "Broaching News". We'll be glad to send you a copy. Ask for issue No. 10.

COLONIAL BROACH COMPANY *147 JOS. CAMPAU ST. DETROIT, U. S. A.*

MANUFACTURERS ASSOCIATION at Hotel Hershey, Hershey, Pa. J. C. McQuiston, manager-secretary, 602 Shields Bldg., Wilkinsburg, Pa.

MAY 31-JUNE 5—Semi-annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Greenbrier Hotel, White Sulphur Springs, W. Va. John A. C. Warner, secretary, 29 W. 39th St., New York City.

JUNE 8-10—Semi-annual meeting of AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Cleveland, Ohio. Secretary, C. E. Davies, 29 W. 39th St., New York City.

JUNE 22-26—Forty-fifth annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary-treasurer, 260 S. Broad St., Philadelphia, Pa.

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Papers on War Production in Lincoln Competition

A procedure for handling competition papers on war production subjects in the James F. Lincoln Arc Welding Foundation's $200,000 Industrial Progress Award Program has been outlined by the Foundation. It is announced that war production subjects are not outside the field of the competition. The many persons engaged in war industry production may expect that their work is covered in one of the forty-six divisions of participation in the competition. If the proper division is not immediately apparent, the necessary information can be obtained by writing the Foundation. Since the competition closes June 1, all persons interested should take the suggested steps immediately.

No one should assume that a paper is barred from submission in the competition until an official opinion has been obtained on the contents from the Public Relations Office of the War Department or of the Navy Department. Detailed instructions can be obtained from the James F. Lincoln Arc Welding Foundation, Cleveland.

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Selection of Lubricants for Ball Bearings

The Annular Bearing Engineers' Committee, 60 E. 42nd St., New York City, of which D. E. Batesole of the Norma-Hoffmann Bearings Corporation, Stamford, Conn., is chairman, has prepared a guide for the selection of lubricants for ball bearings which is available for distribution to those interested. The recommended standards given in this guide have been developed from practical experience.

OBITUARIES

Frederic B. Jacobs

Frederic B. Jacobs, former editor of *Abrasives*, died on January 20 at his home in Cleveland at the age of sixty-two years. Mr. Jacobs was known to many readers of MACHINERY as the author of numerous articles published in the past.

Mr. Jacobs learned the machinist's trade at an early age and became a skilled machinist and toolmaker. As a young man he moved around freely from shop to shop, until in 1908 he entered the employ of the Carborundum Co., Niagara Falls, N. Y. Later he was affiliated with the Abrasive Co., Philadelphia, Pa., and the Nordyke & Marmon Co., Indianapolis, Ind. With the latter company he was assistant to the chief tool designer and supervised part of the work of designing tools for the manufacture of the Liberty airplane engines used in the last World War.

In December, 1918, he left the Nordyke & Marmon Co. and entered the employ of the Penton Publishing Co., Cleveland, Ohio, where he was made editor of *Abrasive Industry* in 1920, and later of *Abrasives*. Mr. Jacobs has written three books on abrasives and grinding and numerous articles, not only for MACHINERY, but for *Steel*, *The Foundry*, and other trade journals. He is survived by his wife and one son.

Thomas J. Connor

Thomas J. Connor, vice-president in charge of production of the Caterpillar Tractor Co., Peoria, Ill., and a member of the board of directors, died suddenly of a heart attack at his home on January 23, aged forty-eight years. Mr. Connor was born in Stockton, Calif., on April 7, 1893. He left high school after one year to become an apprentice at the Geiger Iron Works at Stockton, and after four years became a full-fledged machinist. Following another four-year period with that company, Mr. Connor took a machinist's job with the C. L. Best Gas Tractor Co., where his rise was rapid.

When the Best and Holt companies merged in 1925 to form the Caterpillar Tractor Co., Mr. Connor was placed in charge of the design and production of tools. In 1930 he became general factory manager of the concern; in 1934 he was advanced to the position of vice-president in charge of manufacturing, and was appointed a director of the company.

A. N. LINDBERG, president of the Lindberg Engineering Co. and the Lindberg Steel Treating Co., of Chicago, Ill., died on February 2. Mr. Lindberg was born at Nerke, Sweden, in 1875, and came to the United States in 1893. He was employed by the Crane Co., Chicago, Ill., Fairbanks-Morse Co., Beloit, Wis., and the National Sewing Machine Co., Belvidere, Ill. In 1921, he established the Lindberg Steel Treating Co., and in 1935, together with F. A. Hansen and C. H. Stevenson, formed the Lindberg Engineering Co. Mr. Lindberg was a past-president of the Metal Treating Institute, and was for many years an active member of the Chicago Chapter of the American Society for Metals and the Tool and Die Association of Chicago.

ALAN G. WIKOFF, Editor-in-Chief of the General Publicity Department of Union Carbide and Carbon Corporation, New York City, died in White Plains, N. Y., on February 11 at the age of forty-six. His home was in Pleasantville, N. Y. Mr. Wikoff was graduated from the College of the City of New York with the degree of Bachelor of Science in Chemistry in 1916, and received his Master Degree in Chemical Engineering from Columbia University in 1917. For the last seventeen years, he has been associated with Union Carbide and Carbon Corporation. He was a member of the American Chemical Society, American Welding Society, and International Acetylene Association.

FOREST P. SPRAGUE, direct sales representative of the Lucas Machine Tool Co., Cleveland, Ohio, died on February 7 after a long illness. Mr. Sprague was the Lucas company's first apprentice, over forty years ago, and after rising progressively to the position of foreman, he became a member of the selling staff in 1910.

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Tool Engineers to Meet in St. Louis

The tenth annual convention of the American Society of Tool Engineers will be held in St. Louis, Mo., March 26 to 28. Various aspects of war-time problems will form the subjects to be discussed during the meeting. Conversion from peace to defense production, substitution of materials, conservation of cutting tools, and problems relating to defense inspection are among the subjects that will be considered. One session will be devoted to "Aircraft Mass Production," a subject of great importance on account of the rapid development of the aircraft industry and the importance of this industry to the war effort.